Kawasaki Robotics

ASTORINO

Teach Pendant – User Manual

Introduction

This manual describes the operation of the Teach Pendant for the "Kawasaki Robotics Astorino" educational robot. The manual is valid from firmware version 3.8.4.

ASTORINO is an educational robot that has been specially developed for training establishments and institutions. Pupils and students can use ASTORINO to learn the automation and robotization of industrial processes in practice.

If you have any further questions, please contact local Kawasaki Support.

1. The "astorino" software included with the ASTORINO is licensed for use with this robot only and may not be used, copied or distributed in any other environment.
2. Kawasaki shall not be liable for any accidents, damages, and/or problems caused by improper use of the ASTORINO robot.
3. Kawasaki reserves the right to change, revise, or update this manual without prior notice.
4. This manual may not be reprinted or copied in whole or in part without prior written permission from Kawasaki.
5. Keep this manual in a safe place and within easy reach so that it can be used at any time. If the manual is lost or seriously damaged, contact Kawasaki.

Symbols

Items that require special attention in this manual are marked with the following symbols.

Ensure proper operation of the robot and prevent injury or property damage by following the safety instructions in the boxes with these symbols.

⚠ WARNING

Failure to observe the specified contents could possibly result in injury or, in the worst case, death.

[**ATTENTION**]

Identifies precautions regarding robot specifications, handling, teaching, operation,

⚠ WARNING

1. **The accuracy and effectiveness of the diagrams, procedures and explanations in this manual cannot be confirmed with absolute certainty. Should any un-explained problems occur, contact Kawasaki Robotics GmbH at the above address.**
2. **To ensure that all work is performed safely, read and understand this manual. In addition, refer to all applicable laws, regulations, and related materials, as well as the safety statements described in each chapter.**

Paraphrases

The following formatting rules are used in this manual:

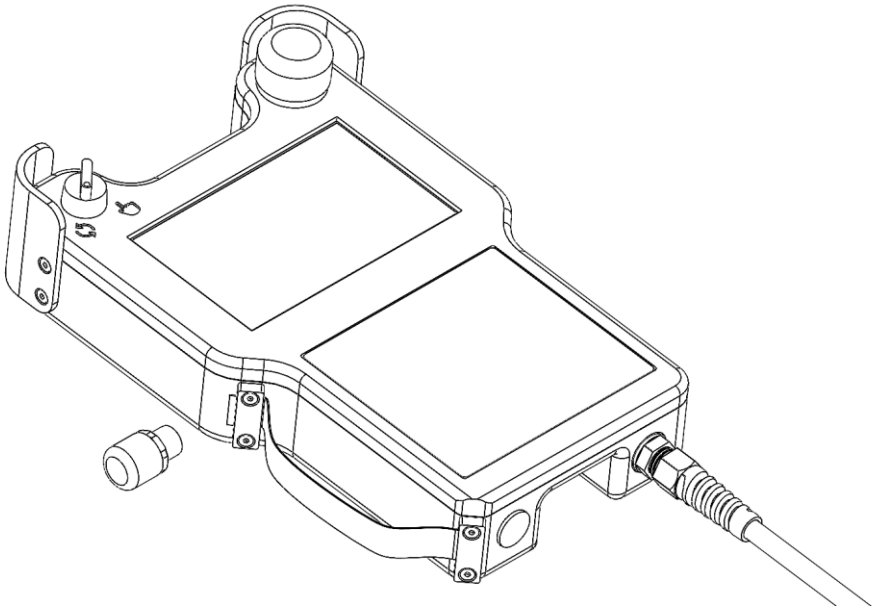
- For a particular keystroke, the respective key is enclosed in angle brackets, e.g. <F1> or <Enter>.
- For the button of a dialog box or the toolbar, the button name is enclosed in square brackets, e.g. [Ok] or [Reset].
- Selectable fields are marked with a square box ☐.
  If selected a check mark is shown inside the symbol ☑.

Table of contents

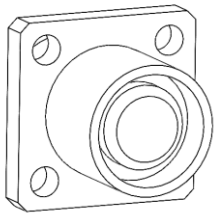
1 Technical specification

Characteristics		Astorino Teach Pendant
Working environment	Temperature	15–35°C
	Humidity	35–60%
Cable length		3 m
Weight		900 g
Power consumption		1.5 W
Screen size		5”
Screen resolution		800x480
Number of colours		65536
Touch screen		Yes - CTP
Material		Aluminium, PET-G, Steel
Colour		Grey/Black

2 Teach Pendant package content

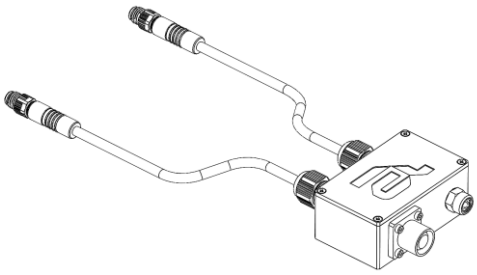


Teach Pendant, Dummy Plug



Only for B-version!

Connection M12 plug



Only for A-version!

Connection adapter

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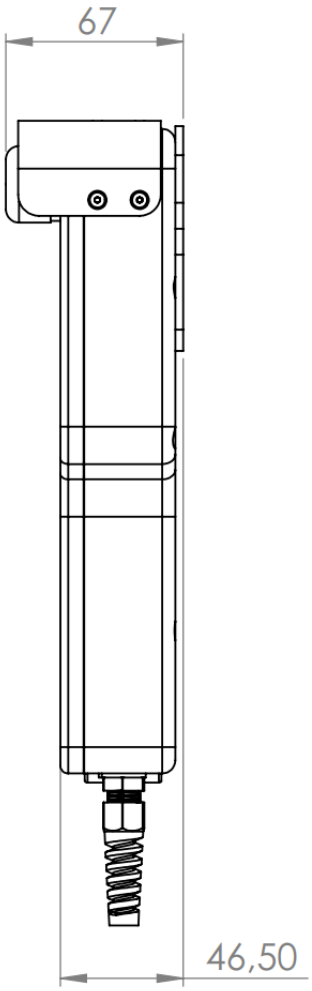
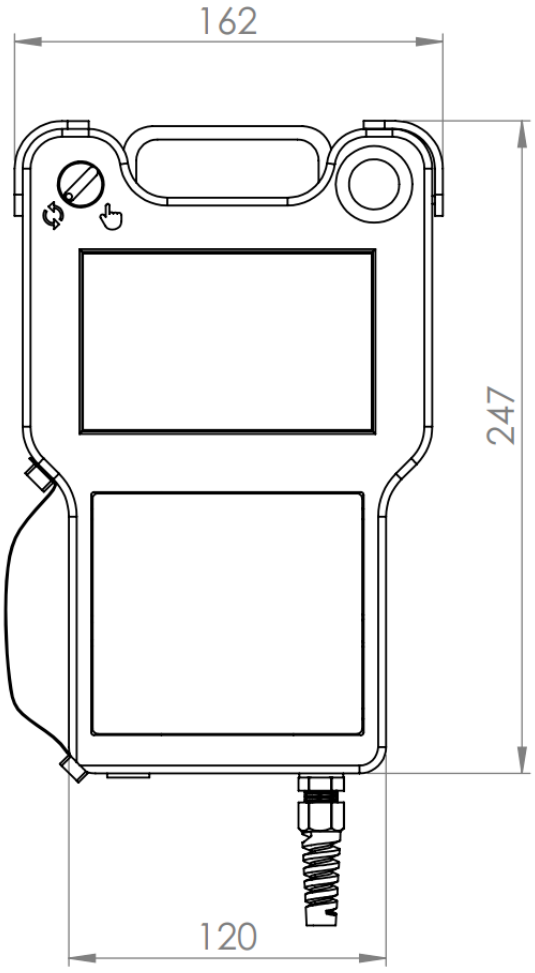
3 Dimensions





4 Connecting the Teach Pendant to the robot

WARNING

Before installation make sure that the robot is TURNED OFF and is installed on the firm surface to avoid any injury!

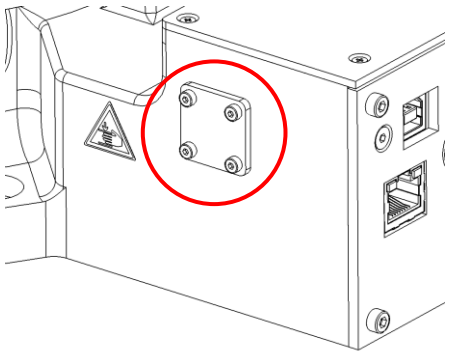
4.1 Robot version B

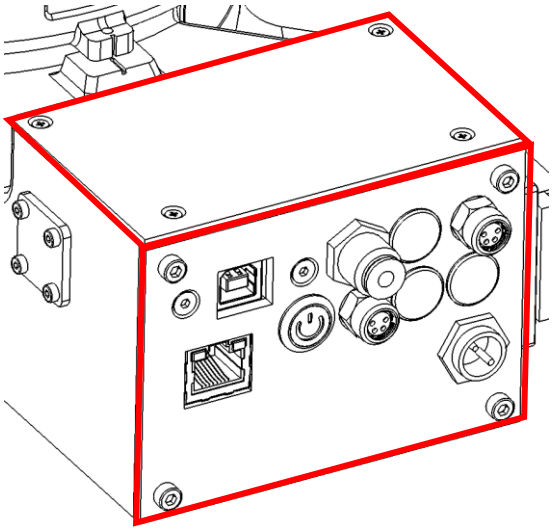
[ATTENTION]

Before connecting the Teach Pendant to the robot, you must update the firmware to at least version 3.8.1!

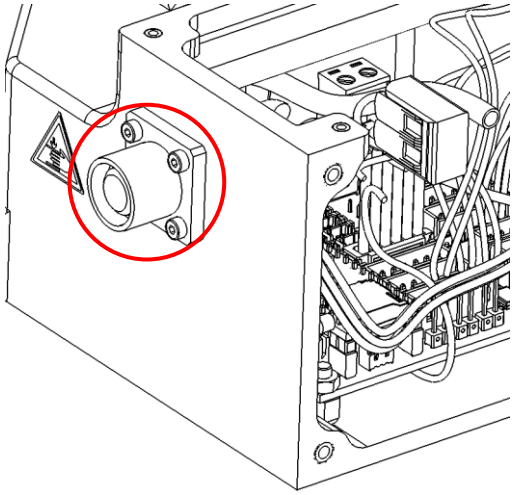
To connect the Teach Pendant to the robot, follow these steps:

1. Upload the latest firmware to the robot (at least 3.8.1)
2. Disconnect the robot from the power supply,
3. Unscrew the TP safety cover and the top and back covers

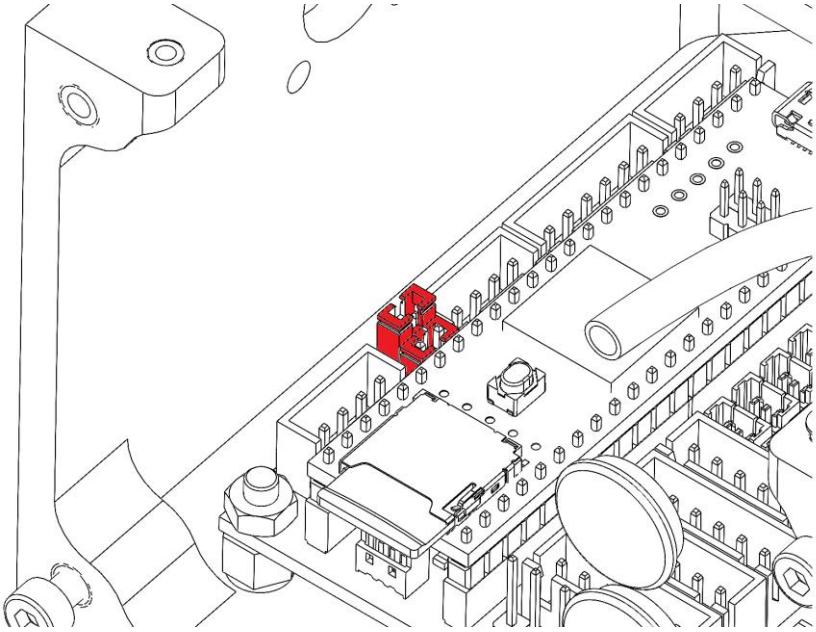




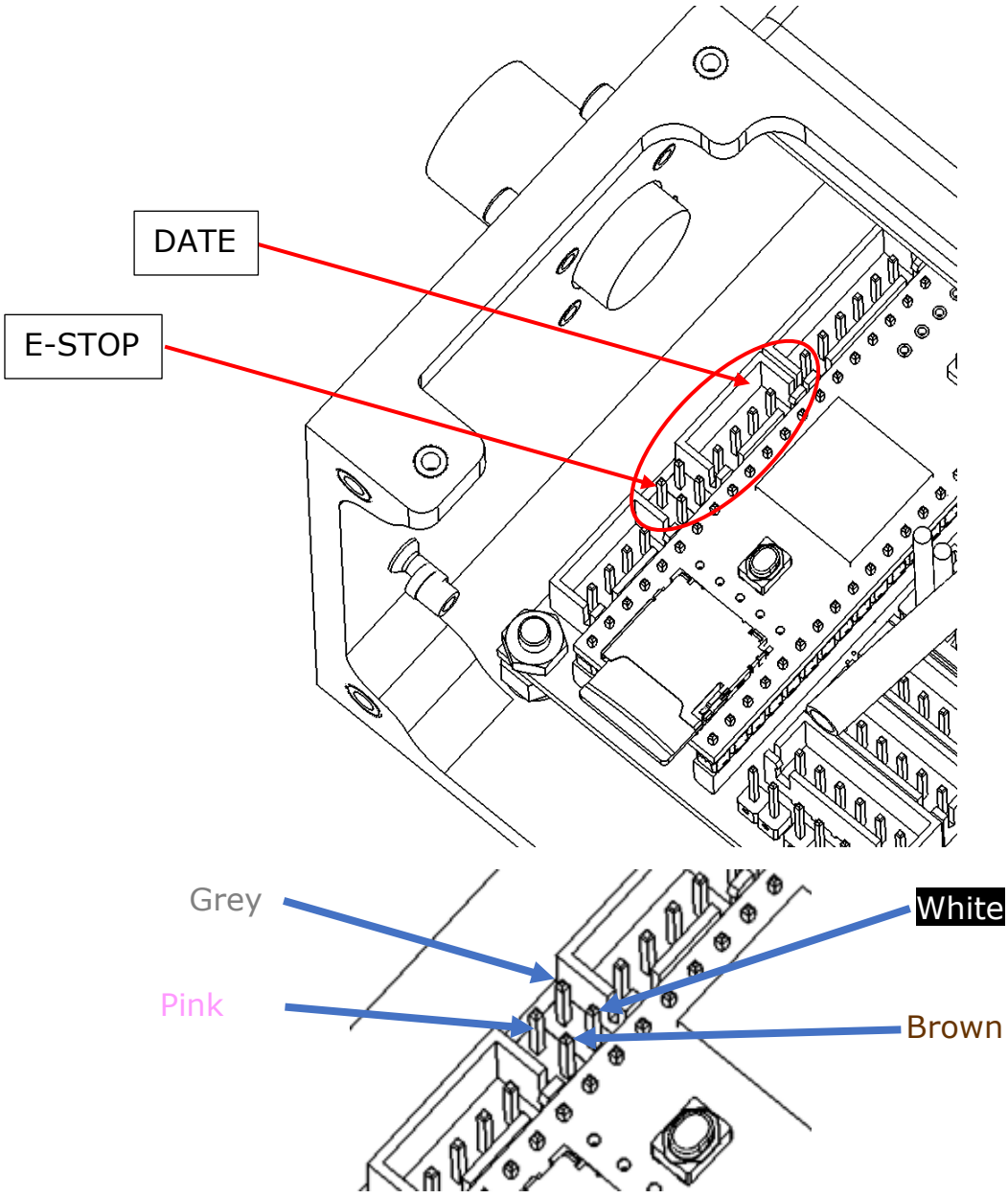
4. Insert the included plug through the hole on the side of the robot base and tighten with the M2 screws you removed earlier



5. Pull out the red E-STOP jumpers,

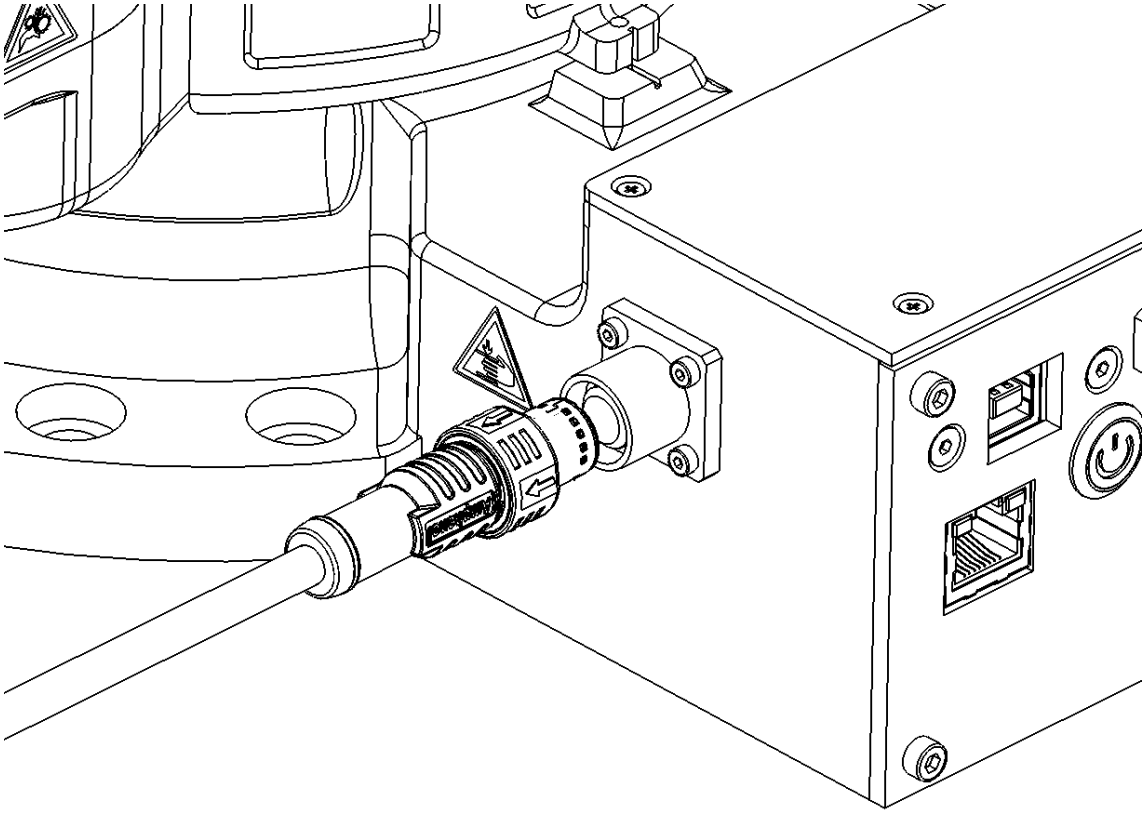


6. Plug in the plugs from the included connector



Colour of the wires in the 4-pin plug

7. Plug the cable from the Teach Pendanta into the previously prepared M12 connector



8. Turn on the robot and check if the Teach Pendant turns on

⚠ Warning

Do not unplug or plug in the Teach Pendant while the robot is powered! This can damage both devices!

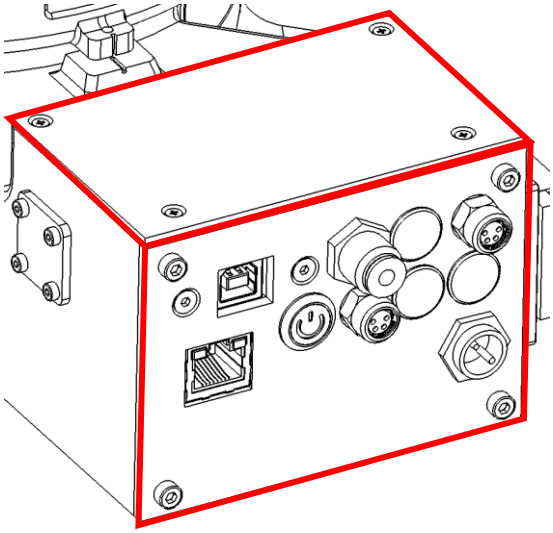
4.2 Robot version A

[ATTENTION]

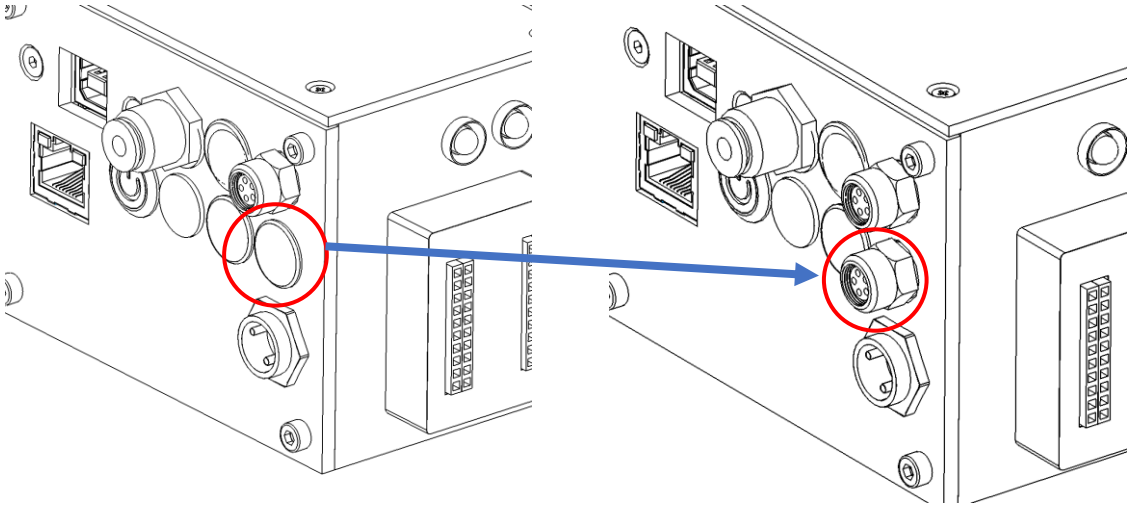
Before connecting the Teach Pendant to the robot, you must update the firmware to at least version 3.8.1!

To connect the Teach Pendant to the robot, follow these steps:

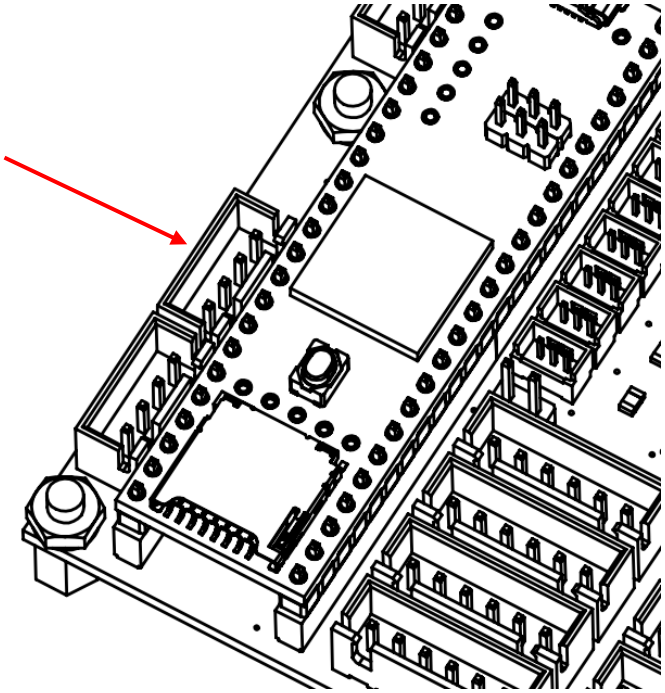
1. Upload the latest firmware to the robot (at least 3.8.1)
2. Disconnect the robot from the power supply,
3. Unscrew the top and back covers,



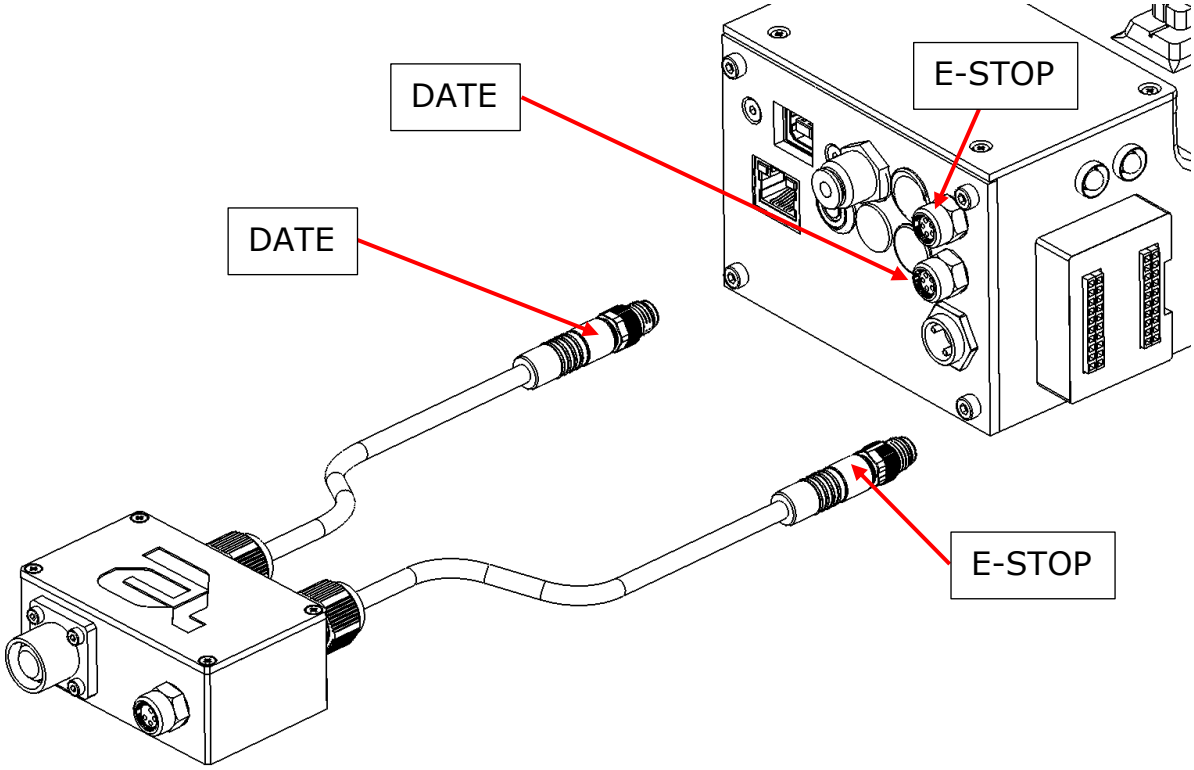
4. Insert the included M8 plug through the hole in the rear panel located under the ESTOP connector.



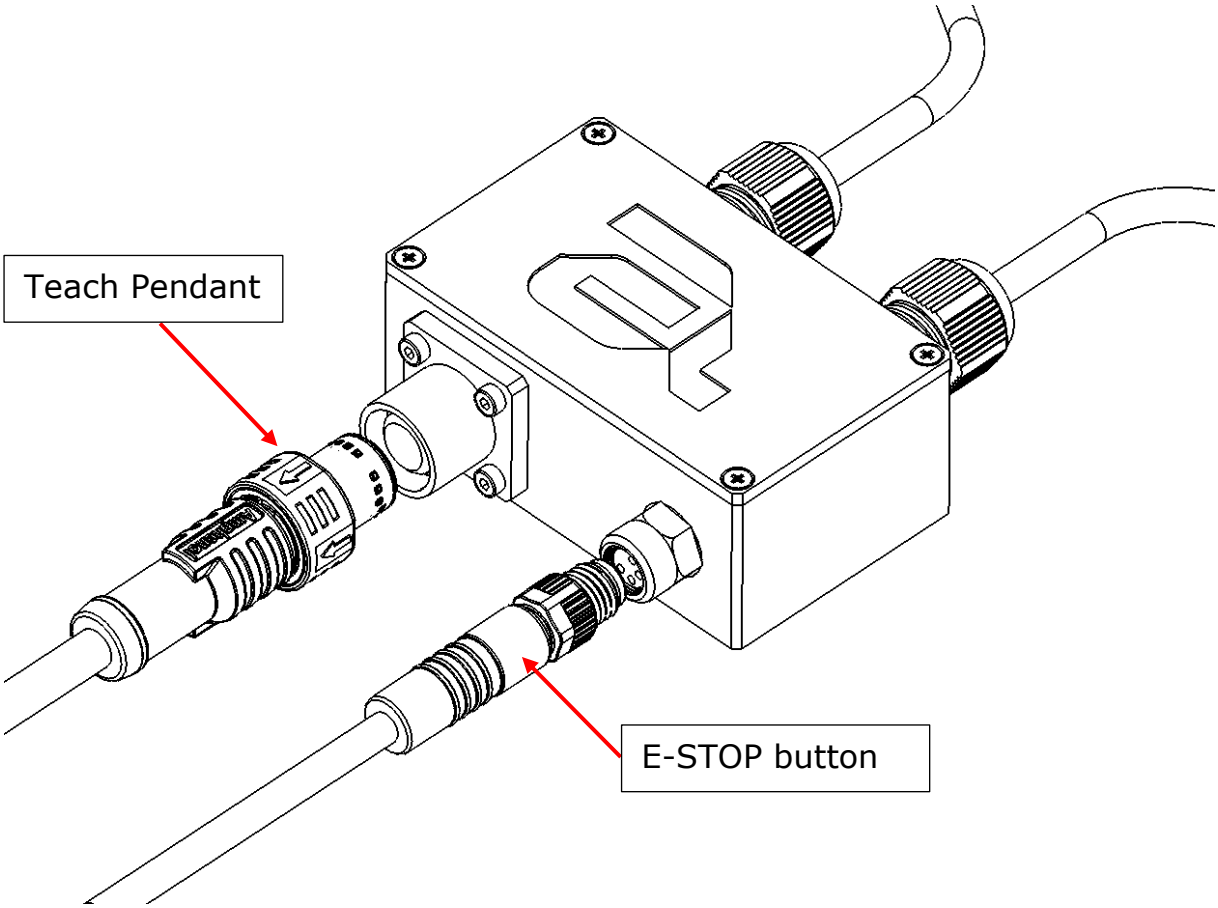
5. Plug the cable from the included M8 plug into the motherboard



6. Close enclosures
7. Connect the included adapter to the robot



8. Attach the cable from the TeachPendant and the safety button to the adapter you previously connected.



9. Turn on the robot and check if the Teach Pendant turns on

⚠ Warning

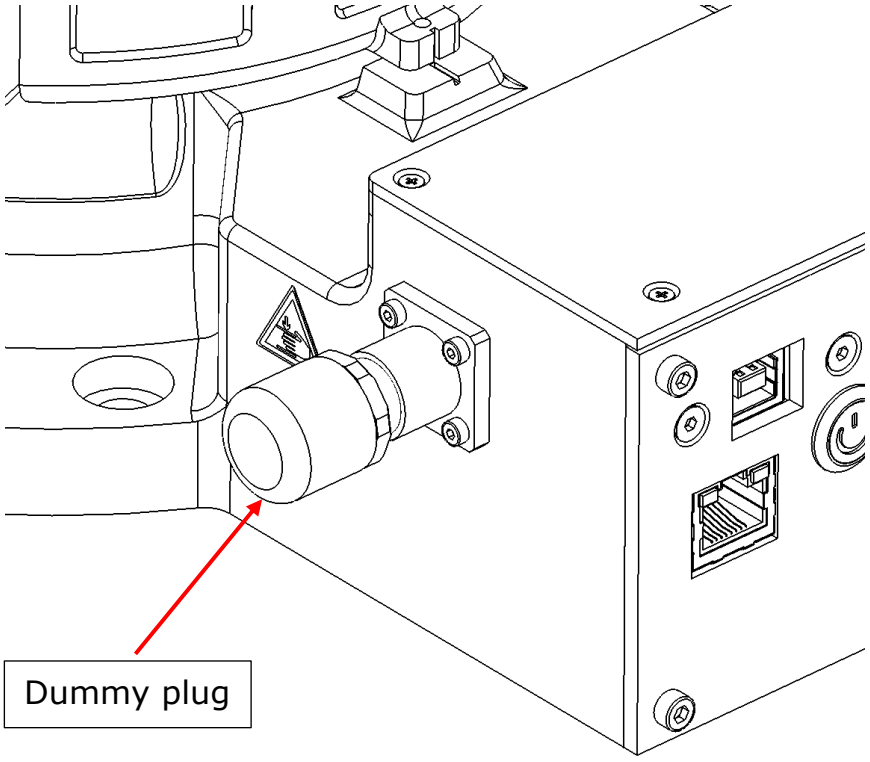
Do not unplug or plug in the Teach Pendant while the robot is powered! This can damage both devices!

5 Working with the robot after disconnecting the TP

When you disconnect the Teach Pendant, the robot will have an Emergency Stop that cannot be reset. This is due to a cut circuit that closes the safety button located on the TP. To short-circuit the cut circuit, replace the TP plug (M12) with the included adapter, the so-called Dummy plug.

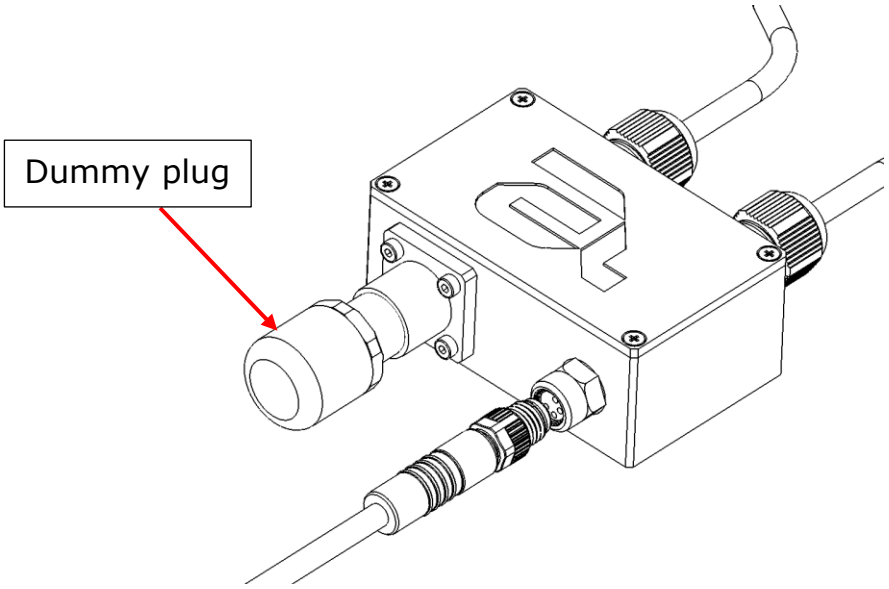
5.1 Version B

The included adapter (dummy plug) should be plugged into the M12 socket located on the side of the robot base

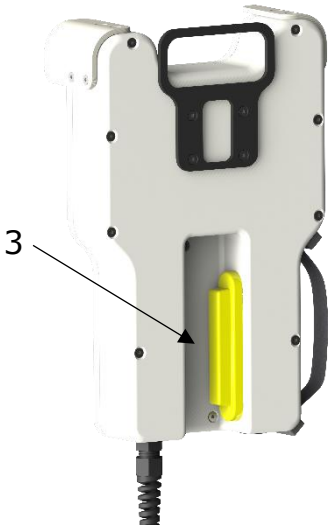


5.2 Version A

The included adapter (dummy plug) should be plugged into the M12 socket located on the ESTOP adapter



6 Physical buttons

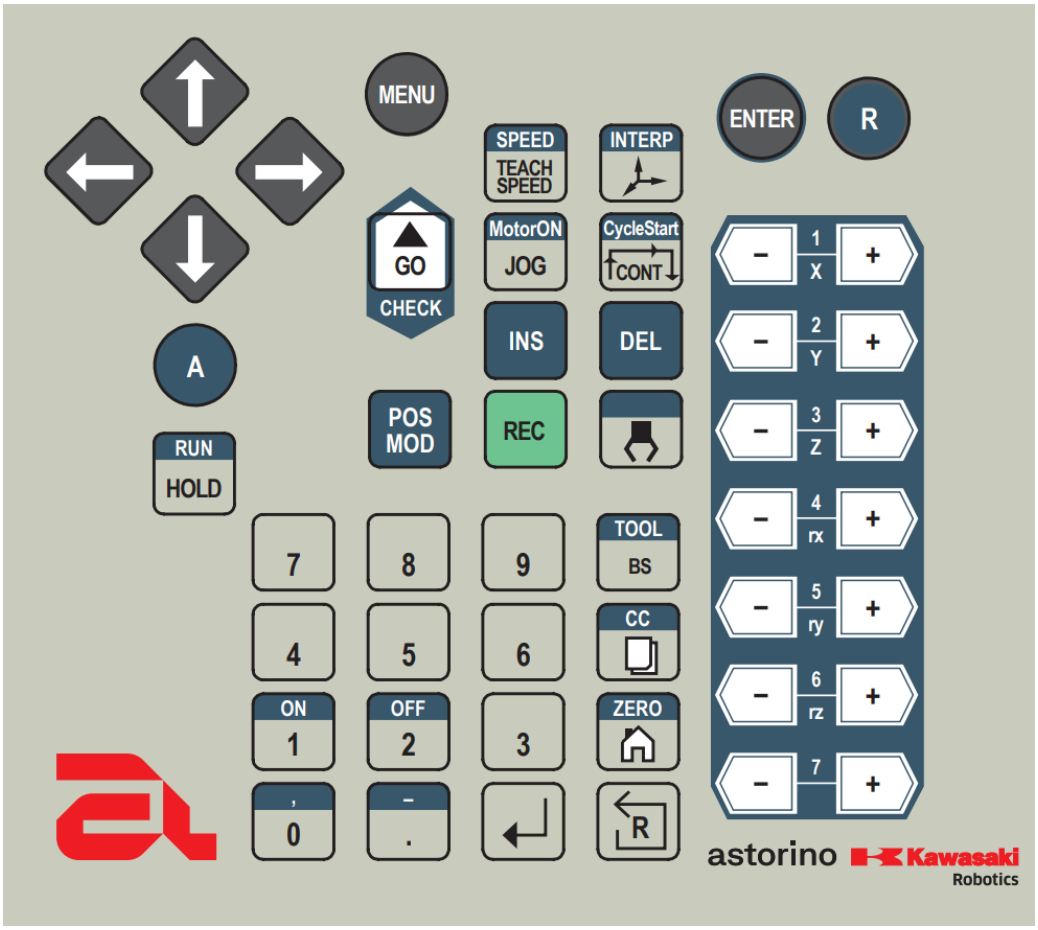


1. TeachLock – a two-state switch for changing the robot's operating mode:
   - TEACH mode
   - REPEAT mode of operation

2. Emergency Stop button

3. Deadman Switch – a three-state switch, only the position in the "middle" state allows the robot to be moved in TEACH mode. The switch in the following positions is off – on – off.

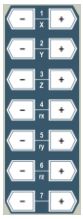
7 Keyboard



Buttons with the described elements of blue have two functions – the basic one (marked on a grey background) performed by clicking only a given button, and the second one (marked on a blue background) is performed by clicking a given button simultaneously with the ALT button - <A>.

Arrow		Navigating through screen options, scrolling through the program
MENU		Opens screen quick selection menu
ENTER		Confirmation of selection
R		Go back to the previous screen
A		ALT – activation of additional button options

SPEED/TEACH SPEED		Changes the Robot's Motion Speed Parameter in TEACH Mode (+ALT) Changes the parameter added to the instruction program
INTERP		Changes the robot's JOG coordinate system in TEACH mode (+ALT) Changes the Parameter of a Motion Instruction Added to a program
GO/CHECK		Execution of the next instruction in the STEP ONCE operating mode or run a single line in Teach Mode
MotorON/JOG		Switching on/off the robot drives (+ALT) Momentary change of robot speed in TEACH mode to a value of 5
CycleStart/CONT		Changing the Continuity Mode of Program Execution (+ALT) Starting/Stopping the robot's program cycle from currently selected line
INS		Adding instructions to the program above the currently indicated line
DEL		Deletion of the currently selected program line (+ALT)
POS MOD		Changes currently selected motion command pose, (+ALT) opens text editor for currently selected line
REC		Adds instructions to the program at the end of the program
Gripper		Version B: switches on clamp signal 1 and switches off clamp signal 2, (+ALT) switching off clamp signal 1 and switches on clamp signal 2
RUN/HOLD		Hold, (+ALT) Resume Operations
Numeric keypad		Entering numeric values in the corresponding functions
ON		(+ALT) Switching on the selected signal

OFF		(+ALT) Switching off a selected signal
TOOL/BS		Backspace – delete the last character (+ALT) – change the selected tool
CC		Opens programs menu, (+ALT) opens programs selection text window
ZERO		Starts the procedure of moving to the home position (+ALT) Starts the Reset Procedure
Reset		Resets the Robot Error
Confirm		Saves/confirms settings
Axes (+/-)		JOG movement along a given axis (depending on the selected system)

8 Screens

Each of the subsequent screens is dedicated to specific functionalities. The following paragraphs describe the functions, touch buttons and markings available on each screen.

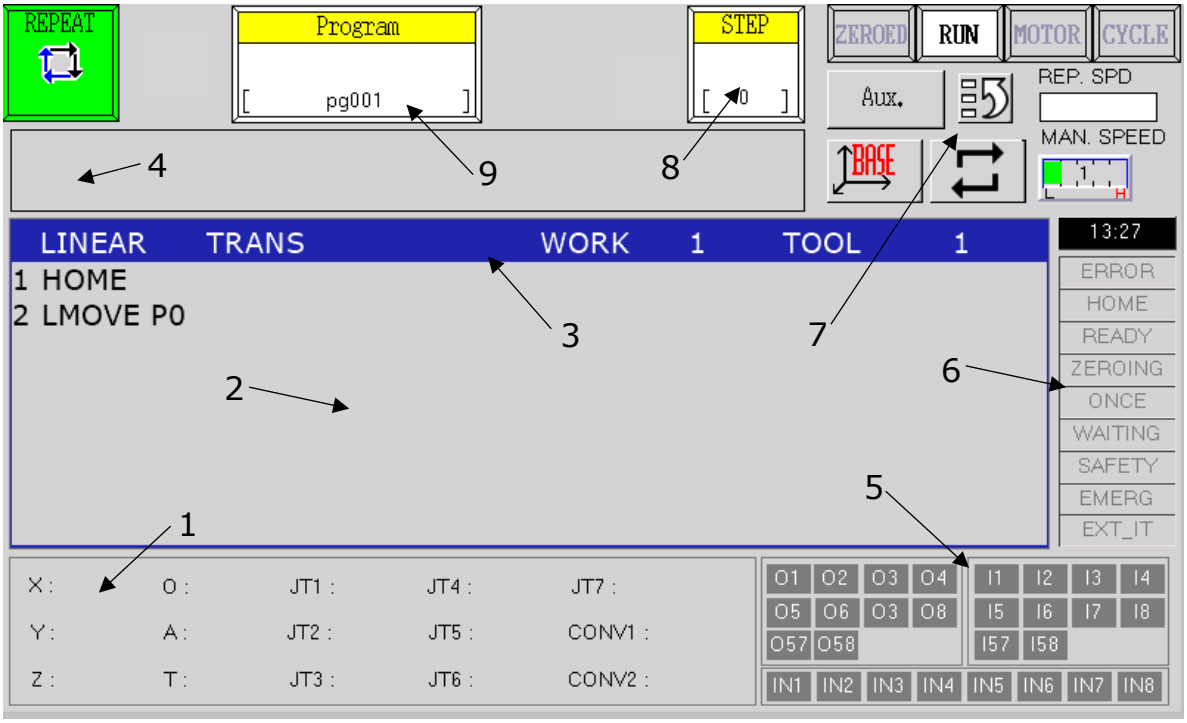
[NOTE]

If there is no user interaction for a minimum of 5 minutes, the screen goes to sleep. To resume working with the screen after entering sleep mode, click any of the keyboard buttons, or the screen anywhere.

8.1 Loading screen

A screen that appears automatically when the robot is turned on with the Teach Pendant connected. A red progress bar indicates that Teach Pendant is turning on correctly and synchronizing with the robot.

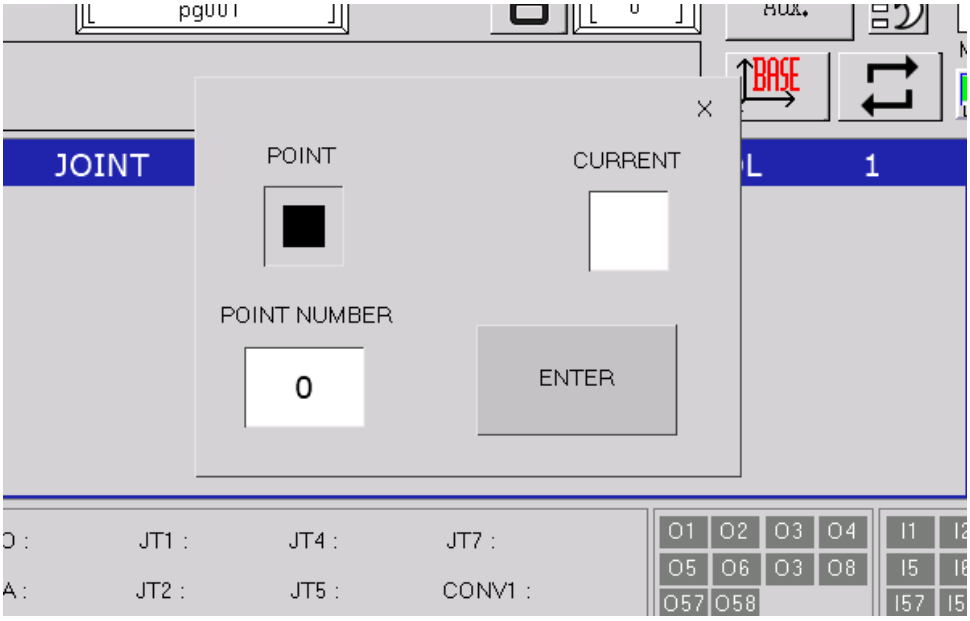
8.2 Block Programming Screen



A basic screen that turns on automatically when you start the Teach Pendant. The main purpose of the screen is to select and create programs, as well as basic signal handling and preview of the robot's status.

1. Current position of the robot
2. Program Display Area
3. Program Instruction Selection Bar
4. Message Display Window
5. IO – inputs and outputs
6. Programming Screen Controls
7. Robot Status Lights and Function Buttons
8. Step of the currently executing program
9. Program Handler Block

8.3 Motion Instruction Point Selection Window



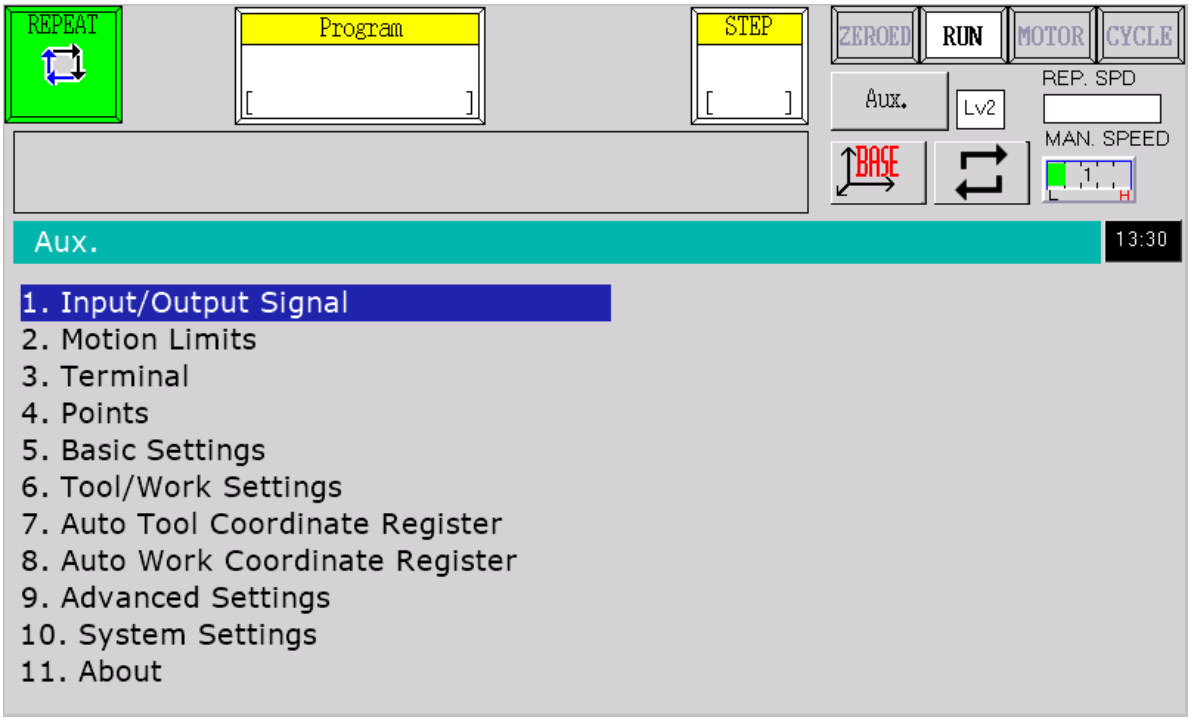
A window that appears automatically when you select the option to add a move instruction. The window allows you to specify the target point of the movement:

POINT – one of the connector points stored in the robot's memory, specified by a number in the "POINT" window,

CURRENT – the current position of the robot, which will be saved in the program using the "#PPOINT" instruction. In this option, the specification of the point number in the "POINT" window is not taken into account.

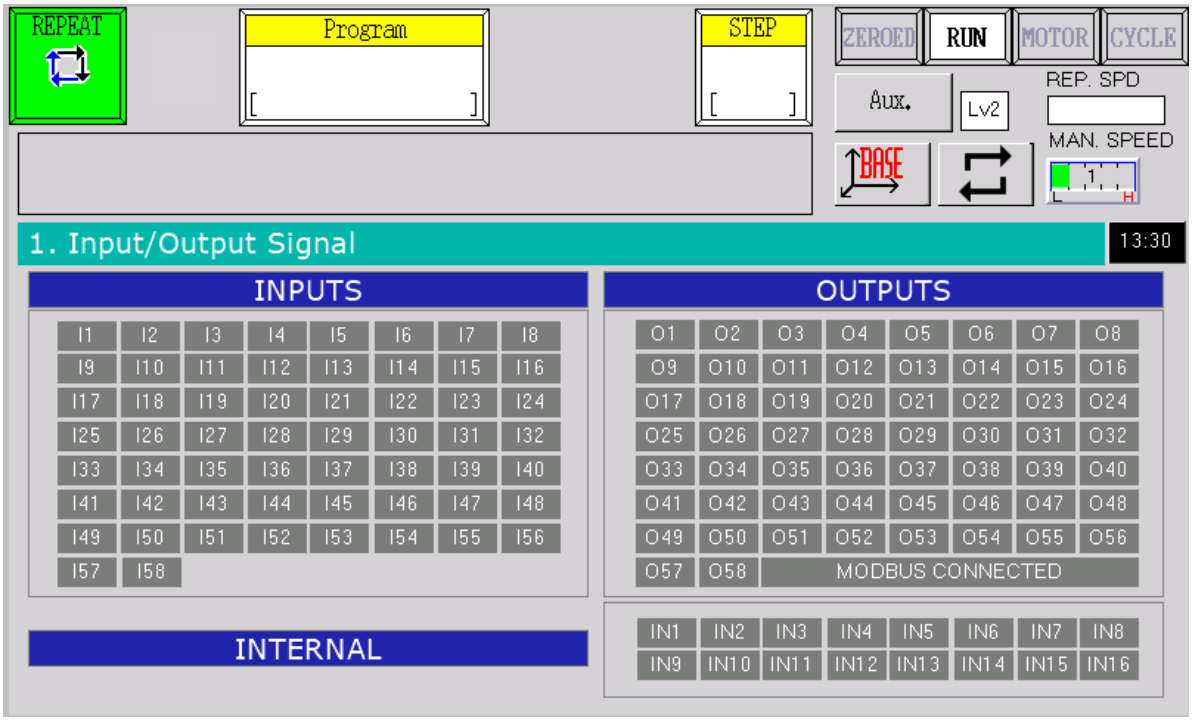
Confirmation of the point selection is carried out by means of the <OK> button.

8.4 AUX menu screen



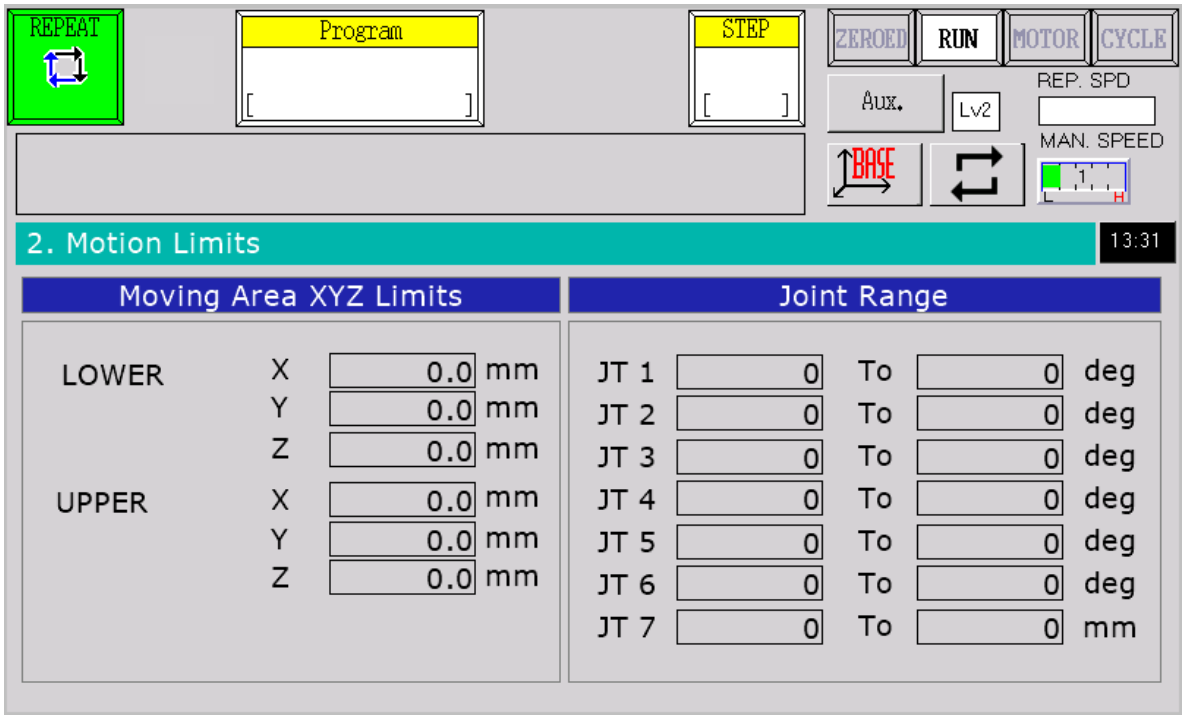
Selection screen for individual function screens. The screen is opened by pressing the <Aux.> button on each screen or by using the physical <MENU> button. Selecting and confirming the listed options opens the screens associated with them.

8.5 I/O Signal Screen



A screen that allows you to operate the physical and internal outputs of the robot and view its inputs. Click specific signal on the screen or use buttons changes their state.

8.6 Motion limits

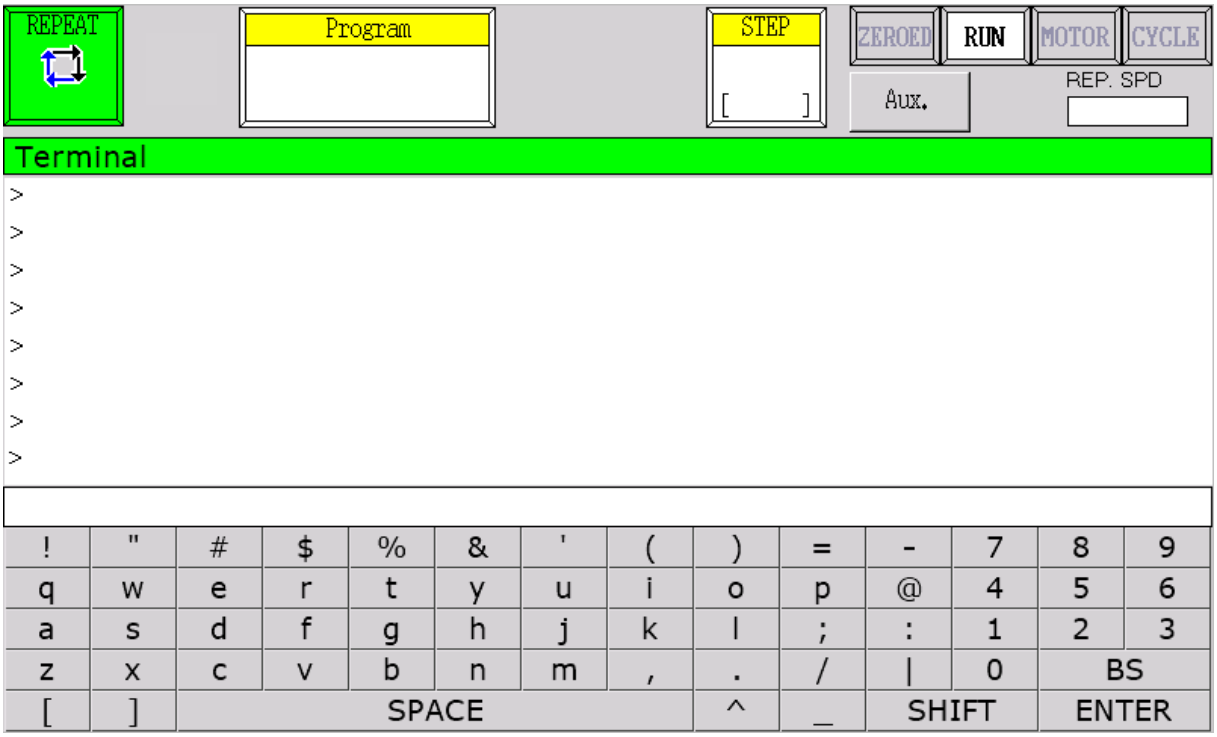


A screen that allows you to change motion limits of astorino robot. User can change Moving Area XYZ Limits and Joints angle. To save the changed settings, set the manual mode (TEACH), check one box from a specific category and click the Confirmations button <↵>. Only the selected category will be uploaded to the robot's memory.

[ATTENTION]

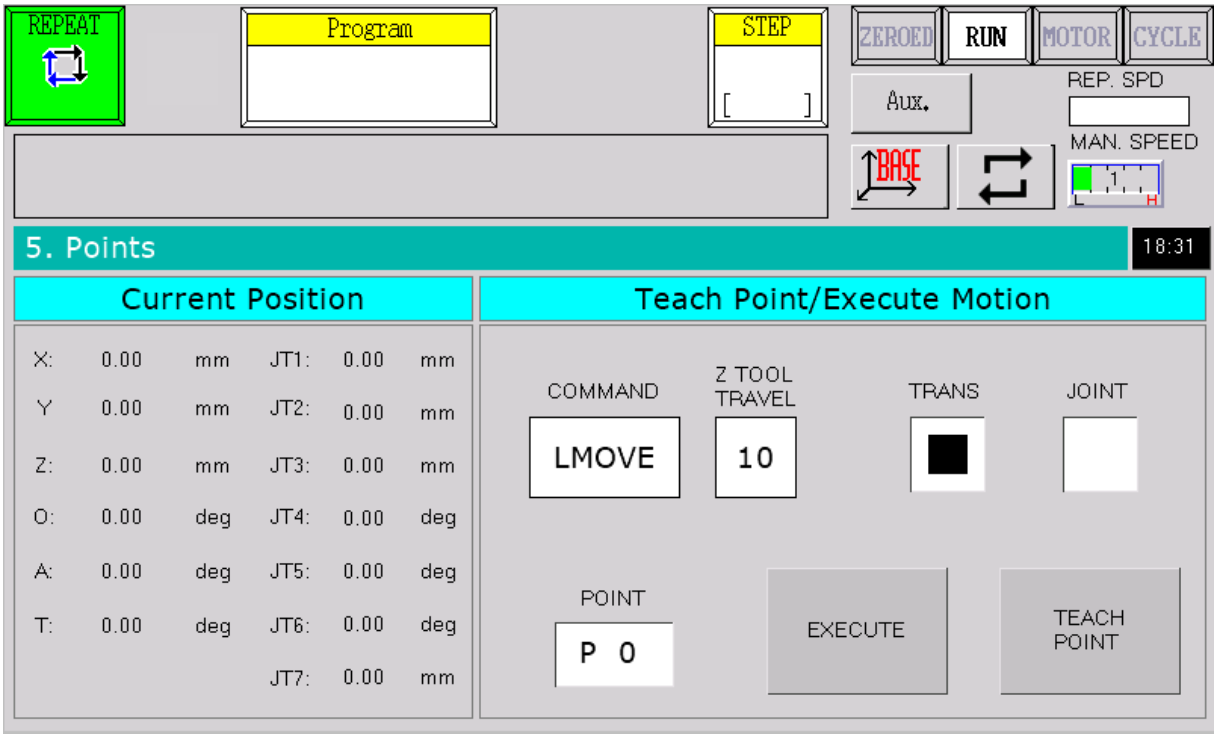
To be able to upload workspace settings, you need to go to the 3rd access level. To do this, type the command "Z_USER 3" in the Terminal on Teach Pendant, to go back to level 2 type "Z_USER 2" or restart the robot

8.7 Command line screen



A screen that performs command-line functions. It allows you to send specific commands to the robot using the on-screen keyboard and the <ENTER> button, and display the messages returned by the robot. To enter a command, type the command using the touchscreen or the arrows on your keyboard. To recall previously used commands, click the up and down arrows on the physical keyboard while pressing the <A> button.

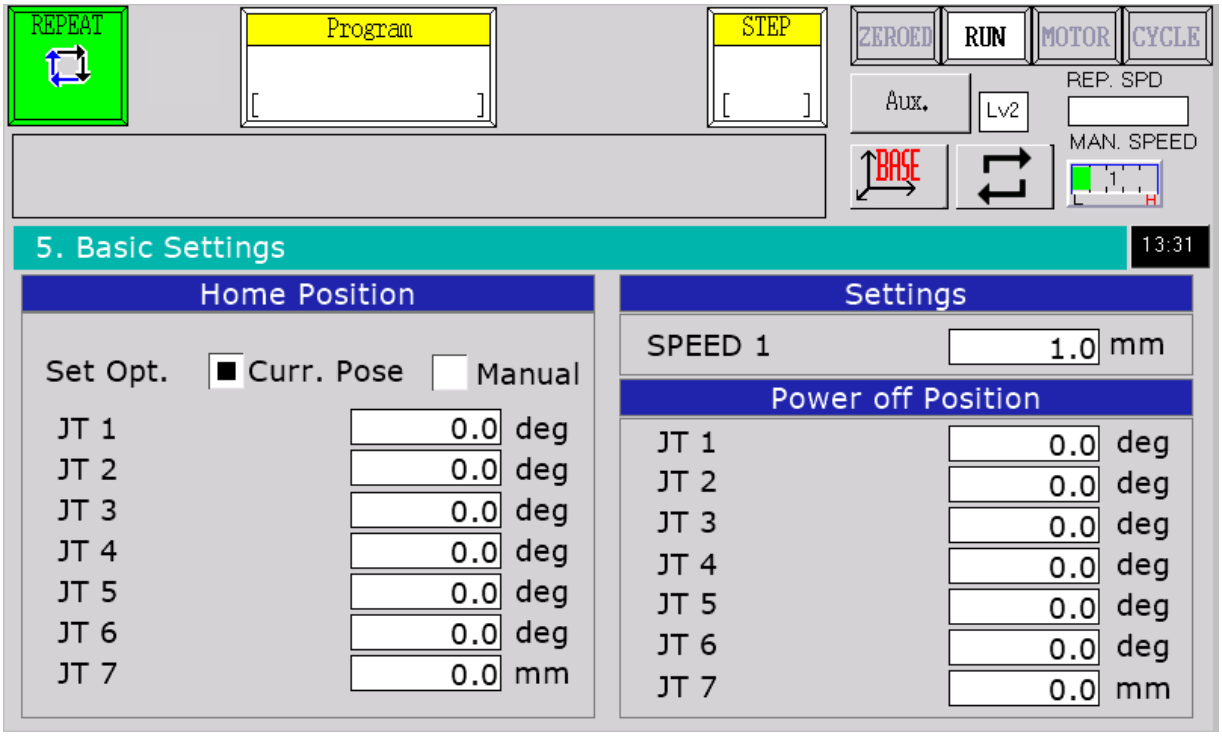
8.8 Points Teaching Screen



A screen that allows the robot to teach points. The <TRANS> and <JOINT> switches allow you to specify the type of point – Cartesian point and junction point, respectively. The point window allows you to select the number of the point to be taught. The <COMMAND> window allows you to specify the movement command that can be executed using the <EXECUTE> button to the currently selected point or the <GO> button on the keyboard. The <Z TOOL TRAVEL> parameter specifies the Z-axis travel distance of the robot tool used by the movement instruction portion.

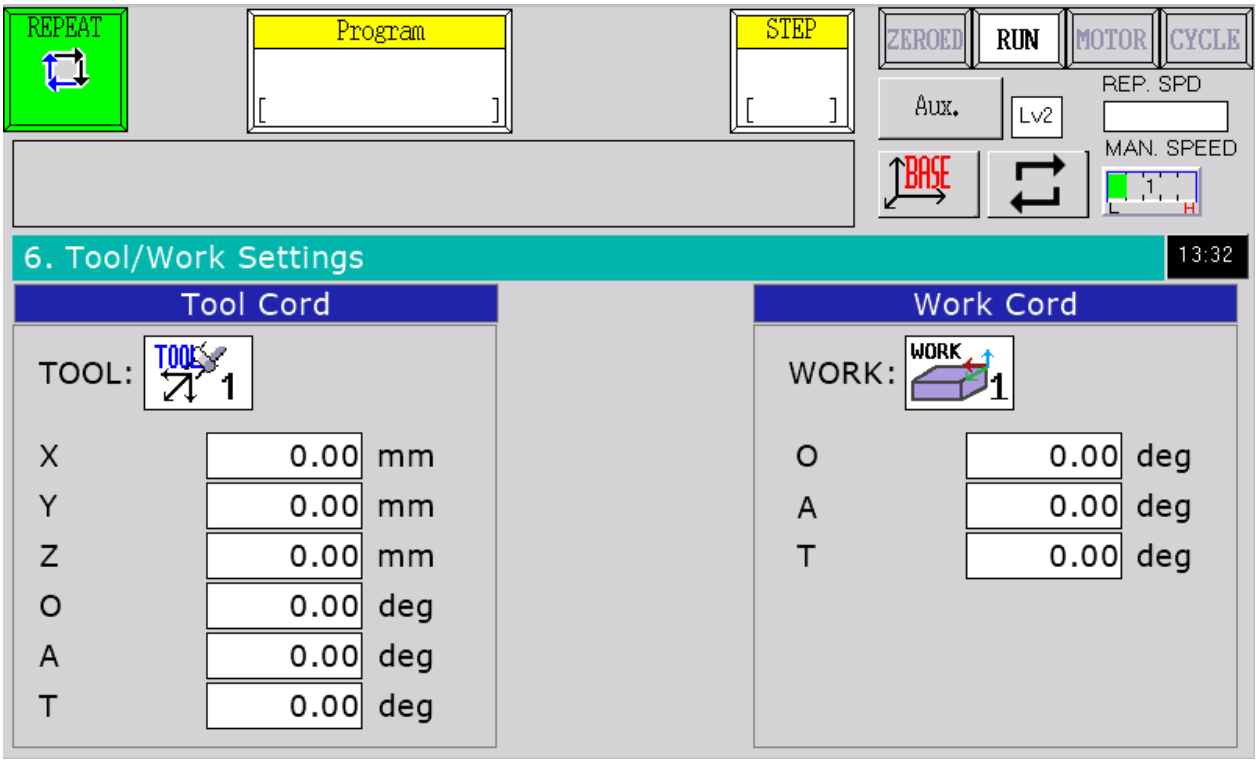
The <TEACH POINT> button allows you to save the current position of the robot to the selected point. You can also teach a point using the <REC> button on your keyboard.

8.9 Basic Settings Screen



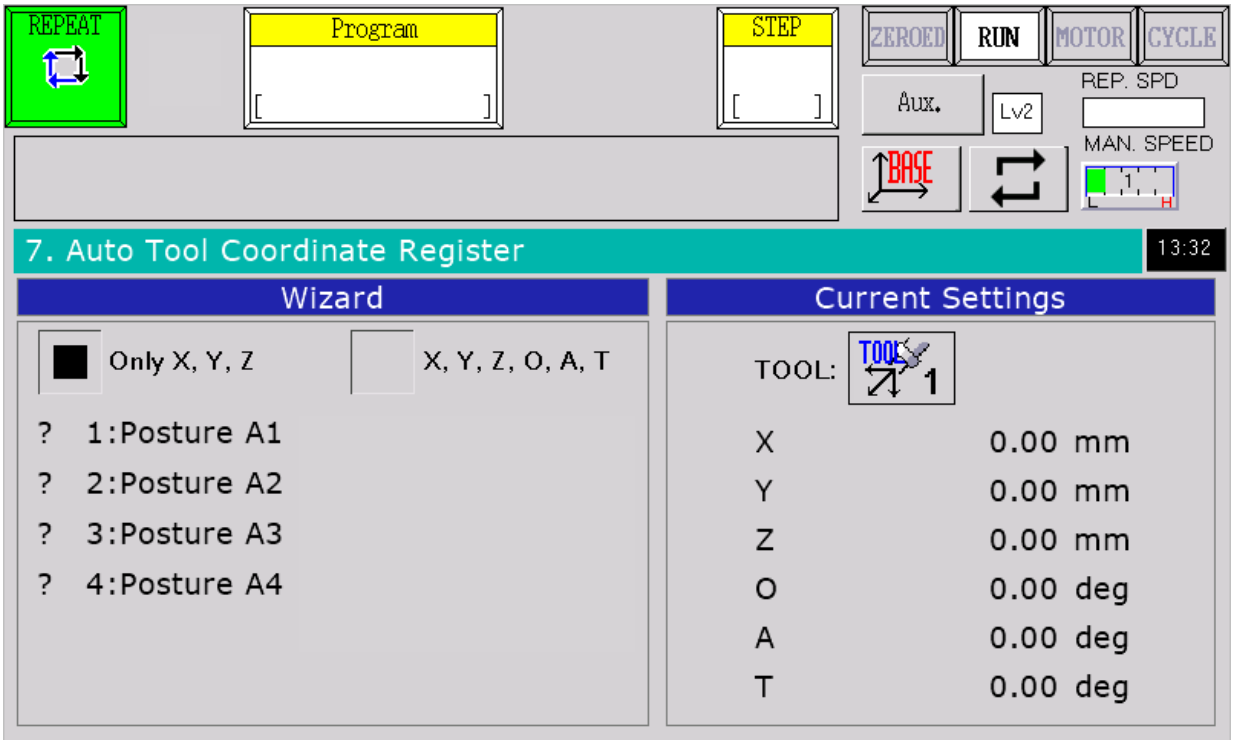
A screen that allows you to change the basic settings of the robot. Here you can change the robot's home position (HOME), the step distance for speed 1 in manual mode (TEACH), as well as change the robot's power off position. To save the changed settings, set the manual mode (TEACH), check one box from a specific category and click the Confirmations button <↵>. Only the selected category will be uploaded to the robot's memory.

8.10 TOOL/Work data settings screen

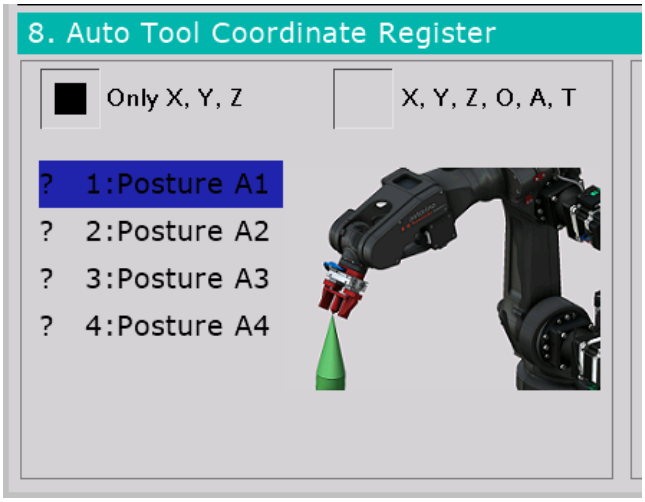


A screen that allows you to change the value of the TOOL and WORK system. When you press the corresponding [X... Rz] you can enter new values. To save the changed settings, click the Confirmations button <↵>.

8.11 Auto Tool Coordinate Register

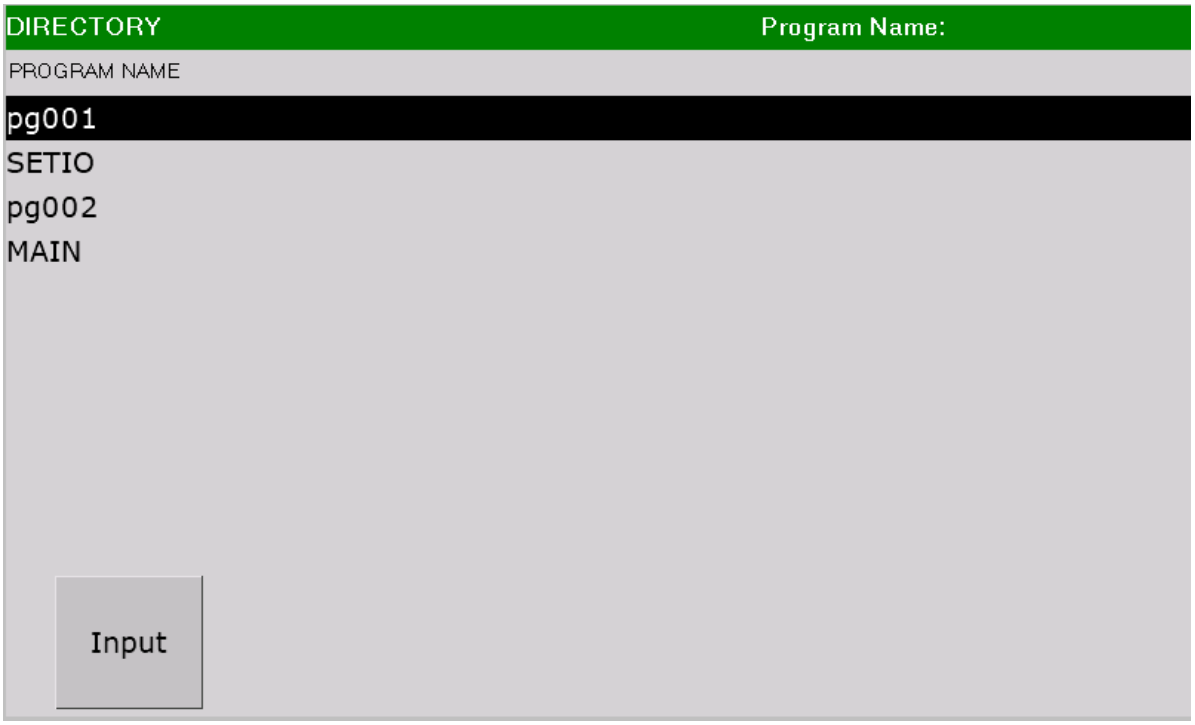


A screen that allows you to determine the value of the TOOL system. Select the appropriate method (four- or six-point) and select the TOOL number to be calculated [1,2 or 3]. After checking the appropriate box [1: Posture A1... 6:Posture C] an example position to which the robot should be reached, after the robot is correctly positioned above the calibration point, press the [REC] button and move to the next point.

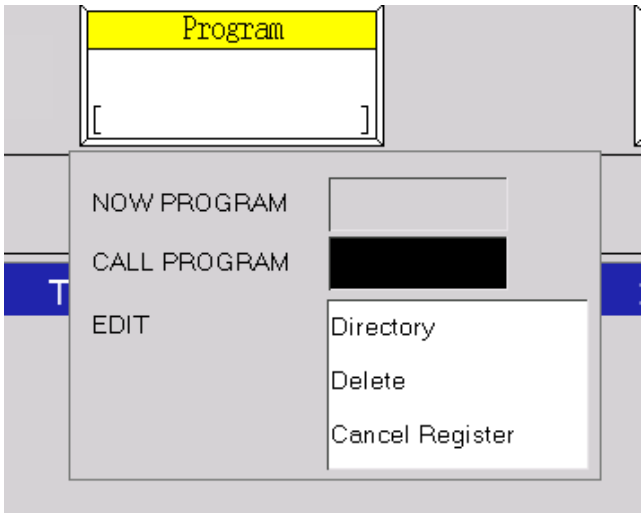


Once you have taught all the points, click the Confirm ↲ button to calculate the new coordinate system.

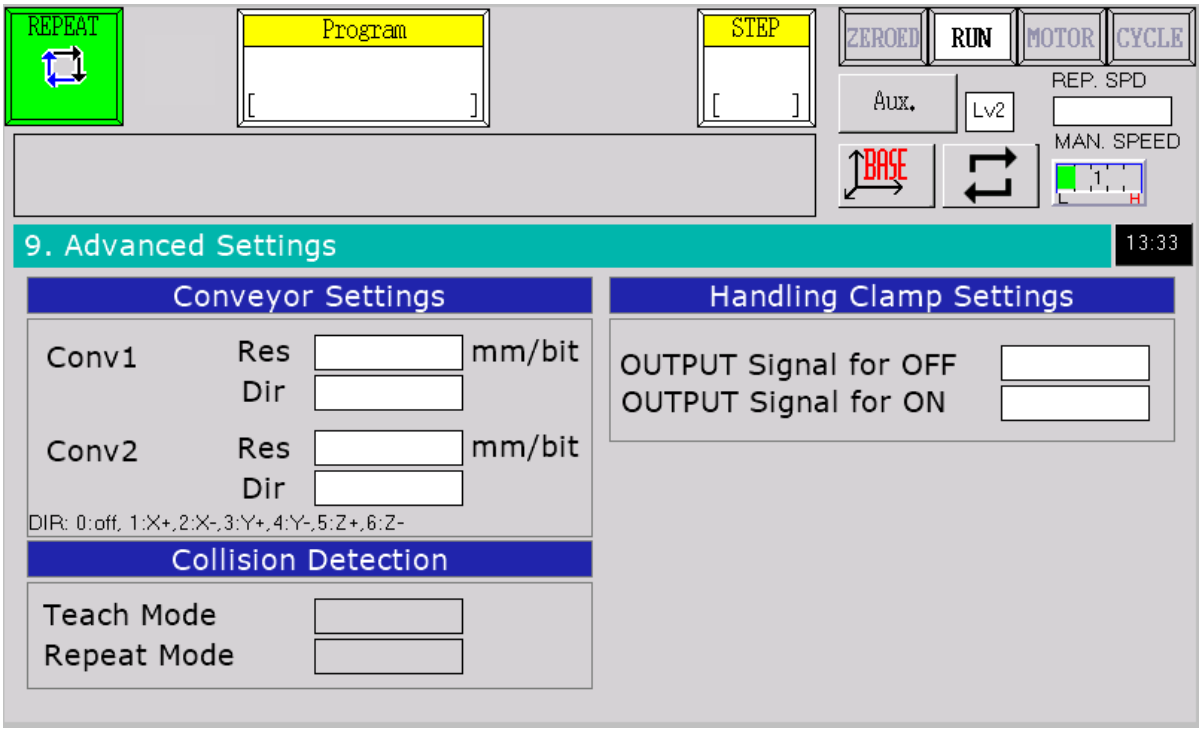
8.12 Program selection window



On this screen you can select a program that needs to be executed. To open that page click Program button on top of a screen and then navigate to Directory



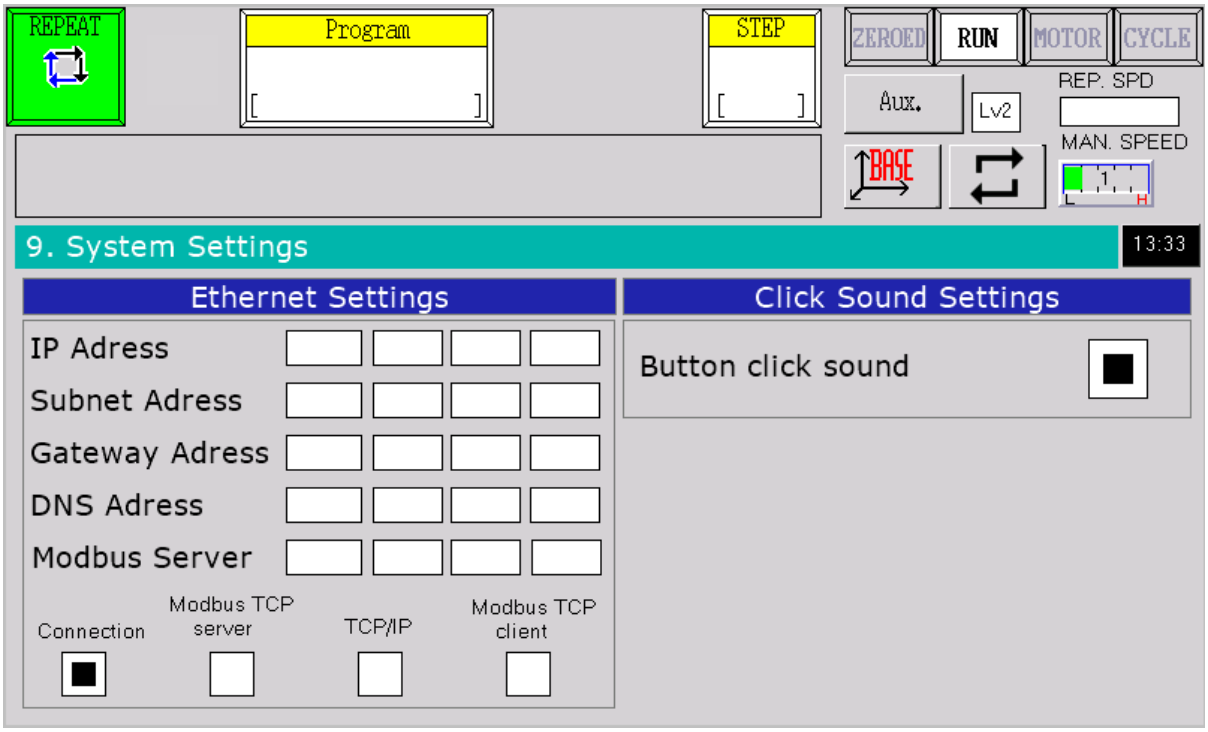
8.13 Advanced Settings



On this page user can change advanced settings like Conveyor settings, Collision Detection and Handling Clamp specification.

Click the Confirmations button <↵>. Only the selected category will be uploaded to the robot's memory.

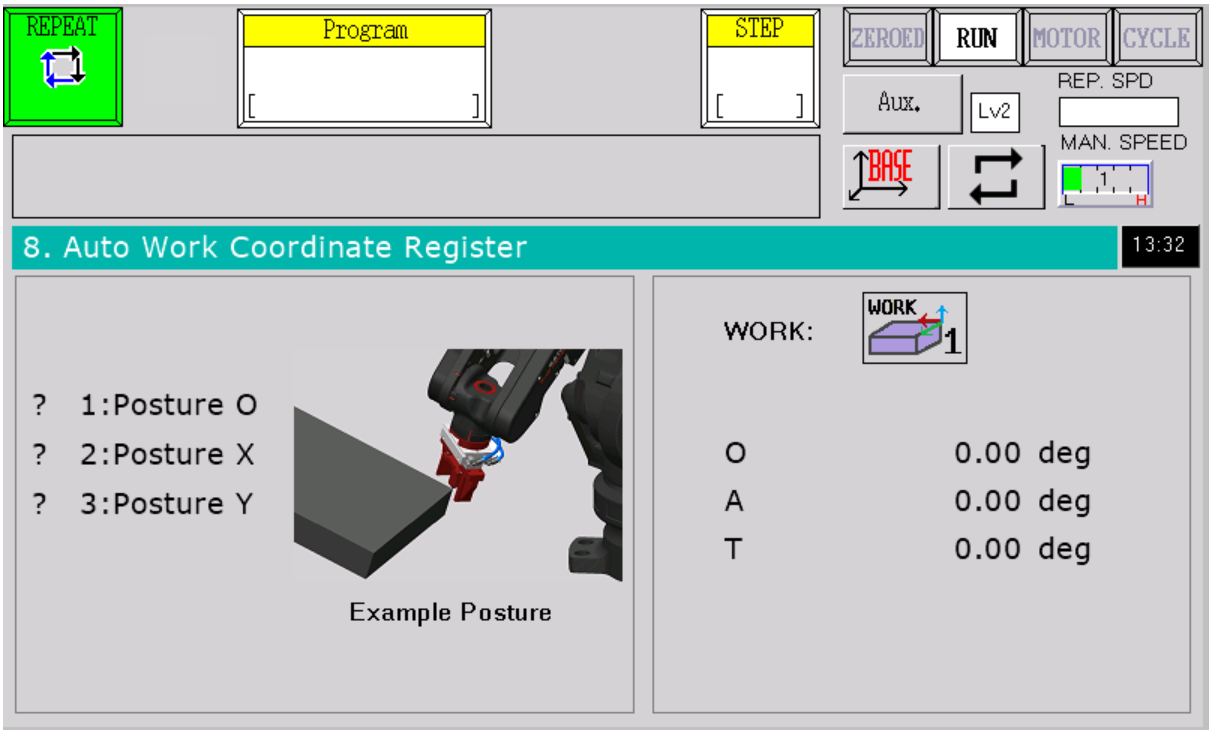
8.14 System Settings



On this page user can change system settings like Ethernet mode, Ethernet Adress and button click sound.

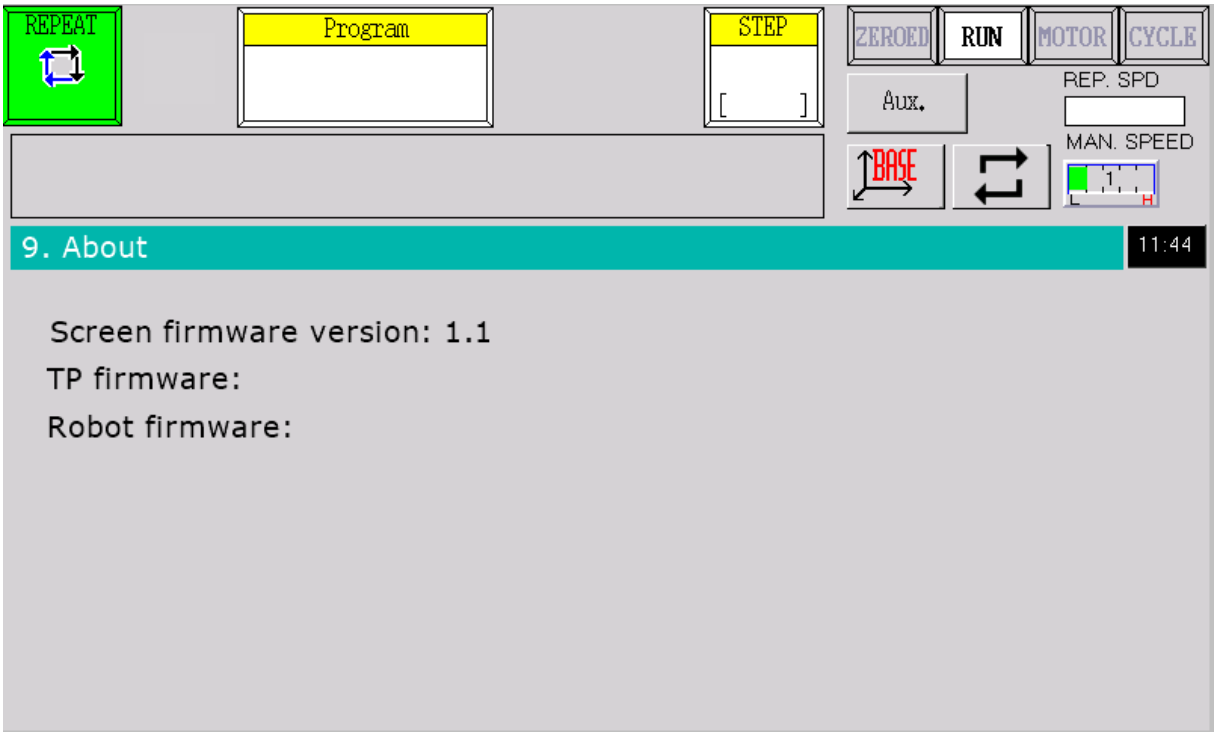
Click the Confirmations button <↵>. Only the selected category will be uploaded to the robot's memory.

8.15 Auto Work Coordinate Register



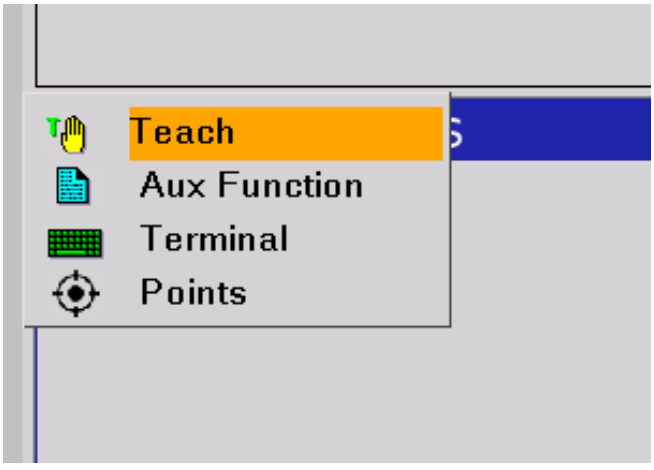
A screen that allows you to determine the value of the WORK system. Select the WORK number to be calculated [1,2]. After checking one of the Postures an example position will be shown to which the robot should be placed, after the robot is correctly positioned above the calibration point, press the [REC] button and move to the next point.

8.16 Info screen



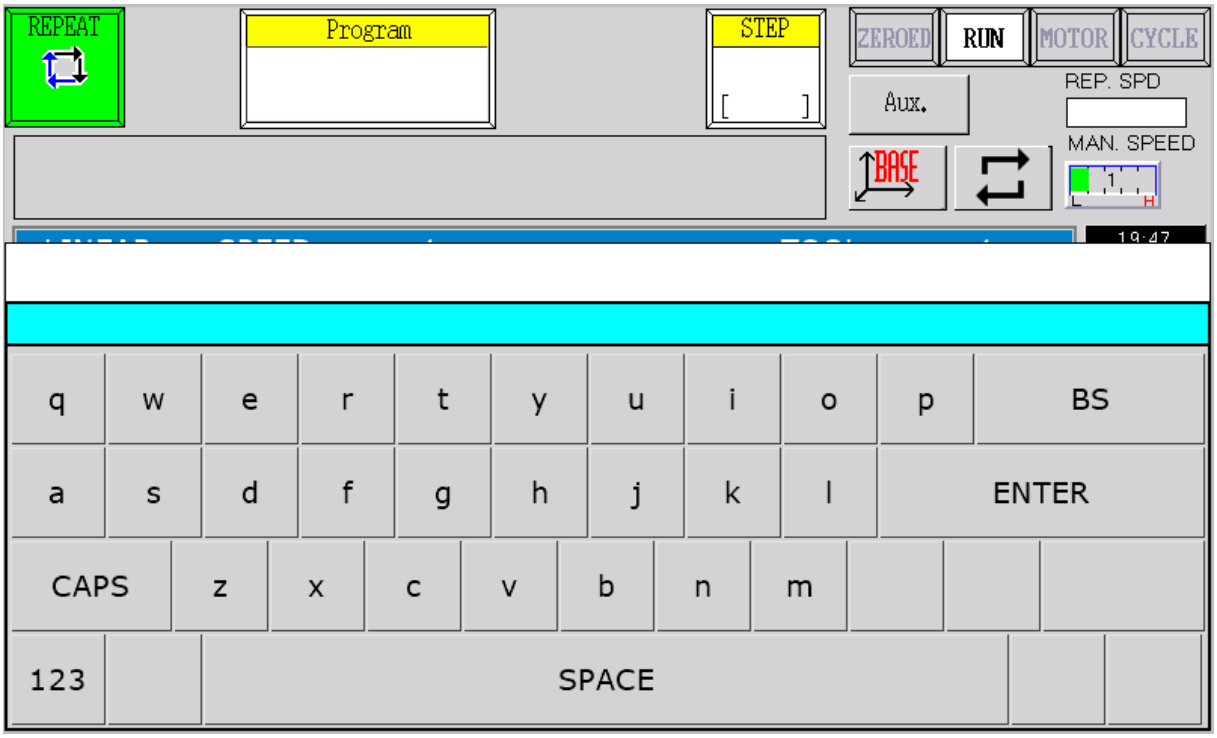
A screen containing basic information about the Teach Pendant software and the ASTORINO robot.

8.17 Quick Navigation Window



This screen appears when you click on the blank fields on any screen, or press the <R> button on the programming screen. Selecting one of the possible Menus will take the user straight to the selected screen.

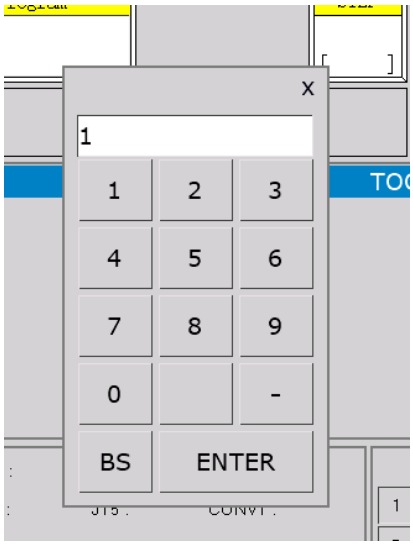
8.18 On-screen keyboard window



The window appears when you select a new program, as well as add any command from the AS language to the program.

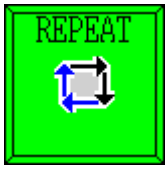
It allows you to type a new name for the program or any text that you want to add to the program.

8.19 On-Screen Keyboard Screen - Numeric

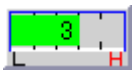
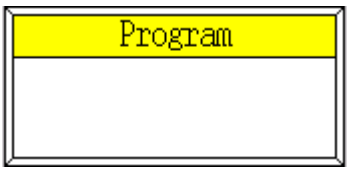


The screen appears when you select an element that accepts numeric data.

9 Robot Status Lights

	Robot in TEACH mode
	Robot in REPEAT mode
	The robot did not pass the zeroing procedure
	The robot has undergone a zeroing procedure
	Robot in HOLD state
	Robot in RUN state
	Robot motors disabled
	Robot motors enabled
	Robots cycle is off
	Robots cycle is on

10 Robot Function Touch Buttons

	BASE (related to the robot base)
	TOOL (related to the robot tool)
	JOINT (associated with each axis separately)
	CONV (related to the conveyor belt cooperating with the robot)
	Operating mode REPEAT CONTINOUS(Automatic subsequent execution of the program upon completion)
	REPEAT ONCE mode
	Monitor Speed(Percentage of the robot speed defined in the program during cycle operation)
	Teach Speed (Five levels of robot movement speed in TEACH mode)
	Program Selection WindowDisplays the name of the currently selected programSelection <NEW> allows you to add a new program by automatically opening the on-screen keyboard to select the program name
	Button to redirect to AUX MENU(Changing the screen to a screen related to AUX MENU)
	A button and indicator light that allows you to set the currently selected program as the startup program, if the button is yellow, the currently selected program is the startup program
	A button and indicator light that allows you to set the currently selected program as a startup program, if the button is gray, the currently selected program is not a startup program
	Skip blocking program commands for example SWAIT

11 Programming Screen Controls

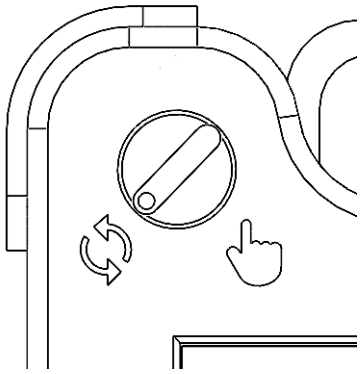
	Robot Operation Error Indication
	Signalling the presence of the robot in the home position
	Robot readiness indication
	Signalling the execution of the zeroing procedure
	Signalling the ONCE mode of execution of program instructions
	Signalling waiting for confirmation of execution of the next program instruction in ONCE mode
	Signalling an error coming from external security
	Indication of an error coming from the emergency stop button
	Signalling the occurrence of an external interrupt – external HOLD
	View the program step that is currently selected or in progress

12 Other controls

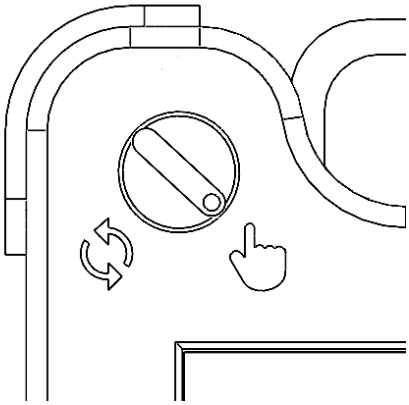
	Current level of access to robot settings from Teach Pendant

13 Switching Operating Modes

To switch the robot to REPEAT mode, switch the Teach Lock to the automatic operating position.



To switch the robot to TEACH mode, switch the Teach Lock to the manual position.

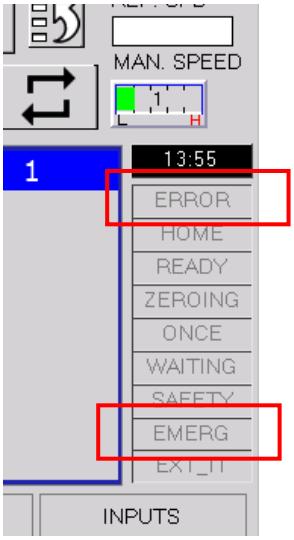


14 Operating and moving the robot in manual mode

[ATTENTION]

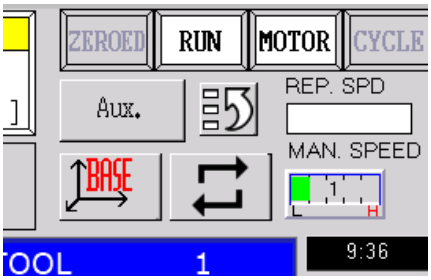
In TEACH mode, every movement of the arm requires the permission button to be activated (Dead man), releasing the allow button during the movement will stop the robot!

When the power is turned on, make sure that the safety button is not engaged. And whether there is an error on the robot.



In the event of an error on the robot, press the <RESET> button on the keyboard.

Then use the <ALT> + <MotorON> buttons to turn on the robot drives. When the drives are turned on, the MOTOR light will be displayed.

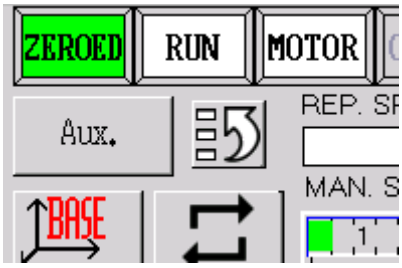


The next step is to activate the reset procedure by selecting the <ALT> + <ZERO> buttons on the keyboard.

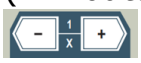
[ATTENTION]

In TEACH mode, the reset procedure requires the allow button (Dead man) attached, releasing the allow button during the procedure will stop the process

When the zeroing procedure is complete, the ZEROED light will be displayed.



In the next step, you can move the robot by moving to the home position (

button) or by using one of the buttons to move the <-> <+ axes> 

[ATTENTION]

After performing the standard zeroing procedure, the robot is in the 0 degree position on each axis (upright) in this position the linear motion is impossible to perform and an error may occur when attempting to move the robot manually in BASE 

, TOOL 

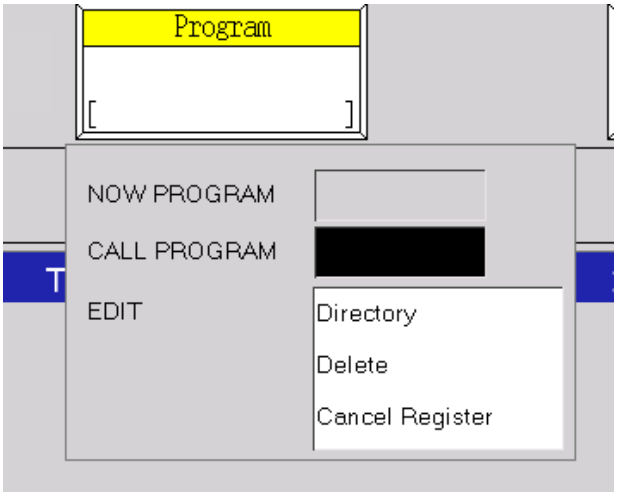
or CONV 

mode . Only a move in a JOINT interpolation 

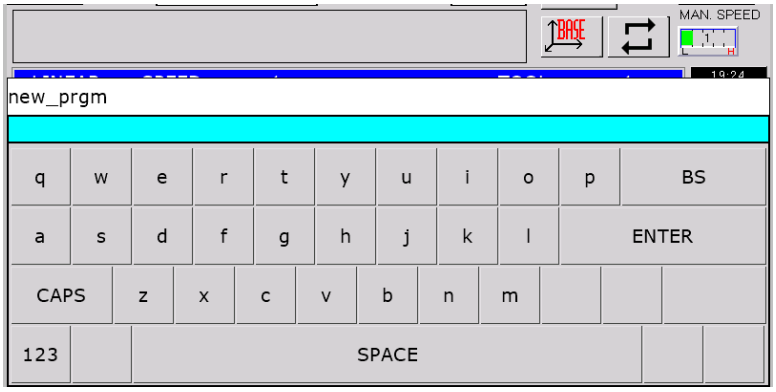
will not cause an error.

15 Creating a new program

To create a new program, click the program selection window in the block programming window. Select [Directory]. Or click [CALL PROGRAM] button.



An on-screen keyboard window will appear where you need to type the name of the program.



When a blank program window appears, you can add further steps via the [REC] button, before selecting the appropriate step:

- LINEAR – linear motion to the point or current position of the robot,
- JOINT – joint movement to the point or current position of the robot,
- C1MOVE – motion in circular interpolation – midpoint,
- C2MOVE – motion in circular interpolation – endpoint,
- SWAIT – adds wait for a signal command,
- TWAIT – adds wait for a certain amount of time command,
- SIGNAL – control of the output or internal signal,
- OPEN – opening the gripper,
- CLOSE – gripper closure,

- HOME – motion to the home position,
- SPEED – adds speed command
- AS Lang – user command, any line from the AS language.

After adding the next step, the program will be automatically loaded into the robot's memory.

16 Teaching Points

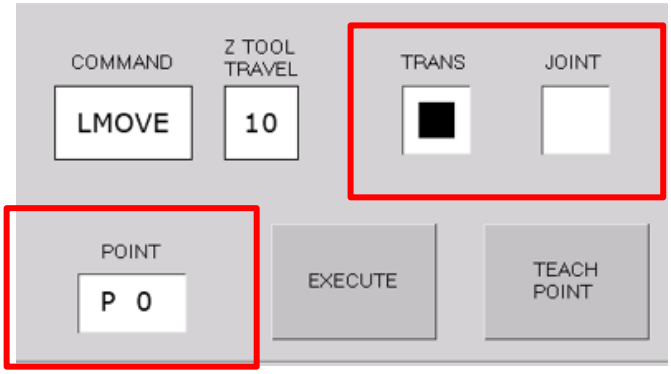
There are two methods you can use to save points to the robot's memory:

- Recording points through the learning screen,
- Saving via the Terminal window

16.1 Save through the Points Teaching Screen

To store a point in the robot's memory, the robot must be in Teach and Ready mode.

We go to window 5. Points, we manually drive the robot to the position we want to save, and then select the type and number of the point we want to save.

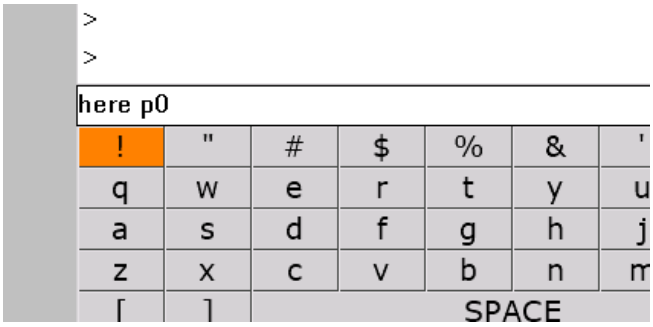


click on the <TEACH POINT> button on the screen or the <REC> button on the keyboard.

16.2 Save via Terminal window

To store a point in the robot's memory, the robot must be in Teach and Ready mode.

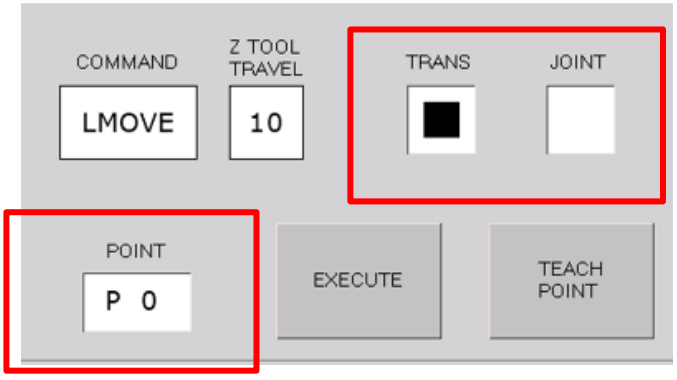
We go to window 4. Terminal, we manually drive the robot to the position we want to save, and enter the command "HERE x", where x is the name of the point. E.g. HERE P0 and press the ENTER button on the screen or the Confirm button <↵>.



17 Moving to a stored points in TEACH mode

To reach the stored point in the robot's memory, the robot must be in Teach and Ready mode.

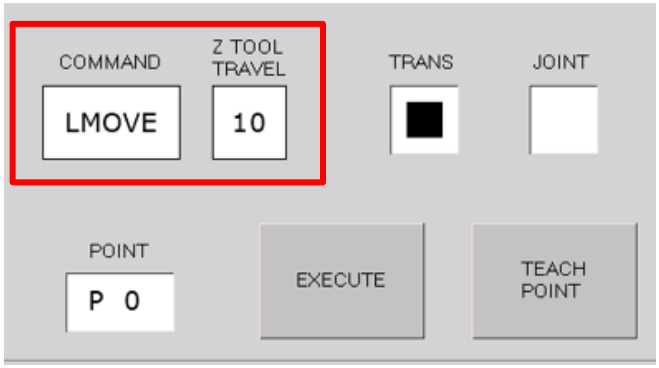
We go to window 5. Points, we manually drive the robot to the position we want to save, and then select the type and number of the point we want to reach.



We choose the type of traffic:

- LMOVE
- JMOVE
- LAPPRO
- JAPPRO
- JUMP

If you choose LAPPRO, JAPPRO or JUMP, you must also enter the value of the distance at which the robot should depart or approach a given point.



To start the move, press the <EXECUTE> button or the <ALT> + <GO> button on your keyboard.

18 Firmware update

The Teach pendant software consists of two files:

- *.hex, which is the software of the Teach Pendant driver,
- *.tft, which is the screen software.

During the update process, you will need the following:

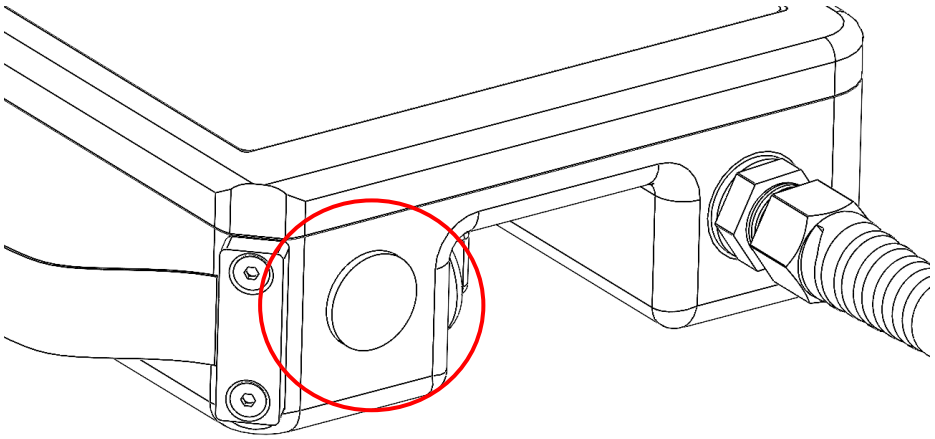
- Micro USB Cables
- Any FAT32 formatted microSD card (32 Gb max)
- Allen key 2.5

[ATTENTION]

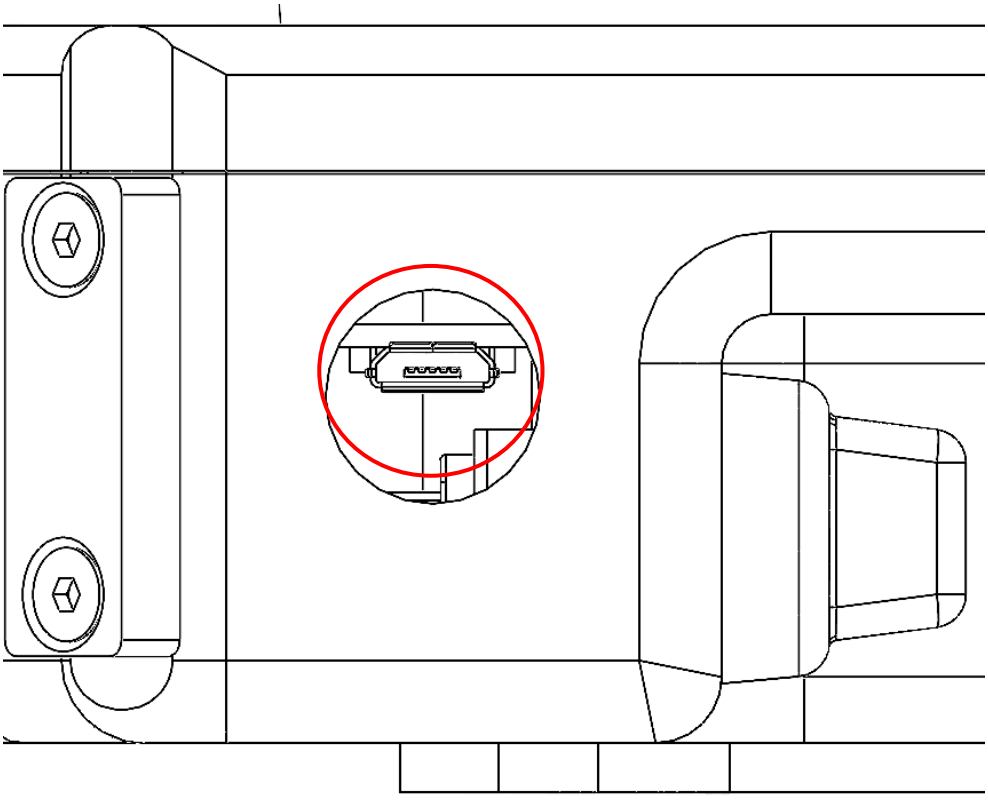
When updating the Teach Pendant software, always upload both files!

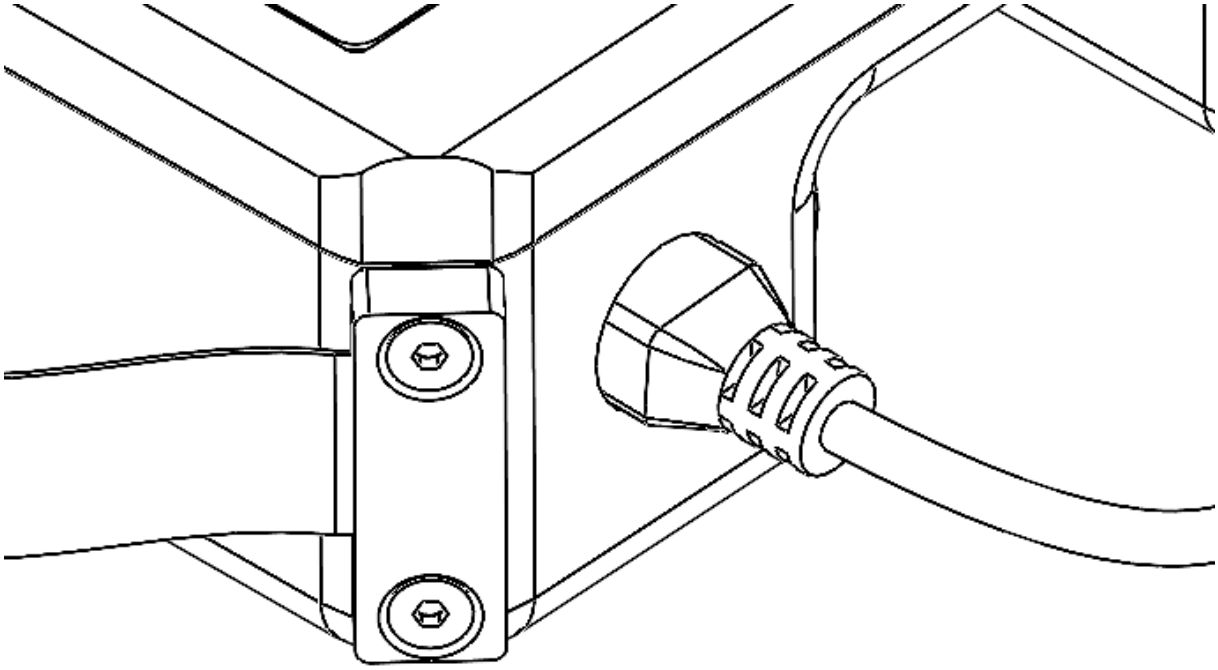
18.1 Teach Pendant Controller Software Update

1. To update the Teach Pendant controller's firmware, you need to remove the black cap at the bottom.



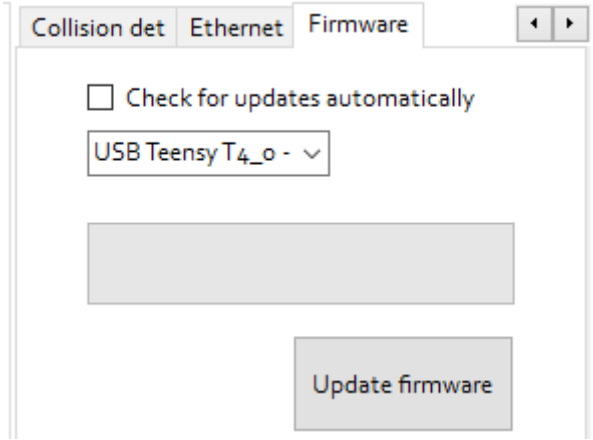
2. Then connect the USB cable of the micro chip inside to the PC.





3. Turn on the robot with the Teach Pendant connected.

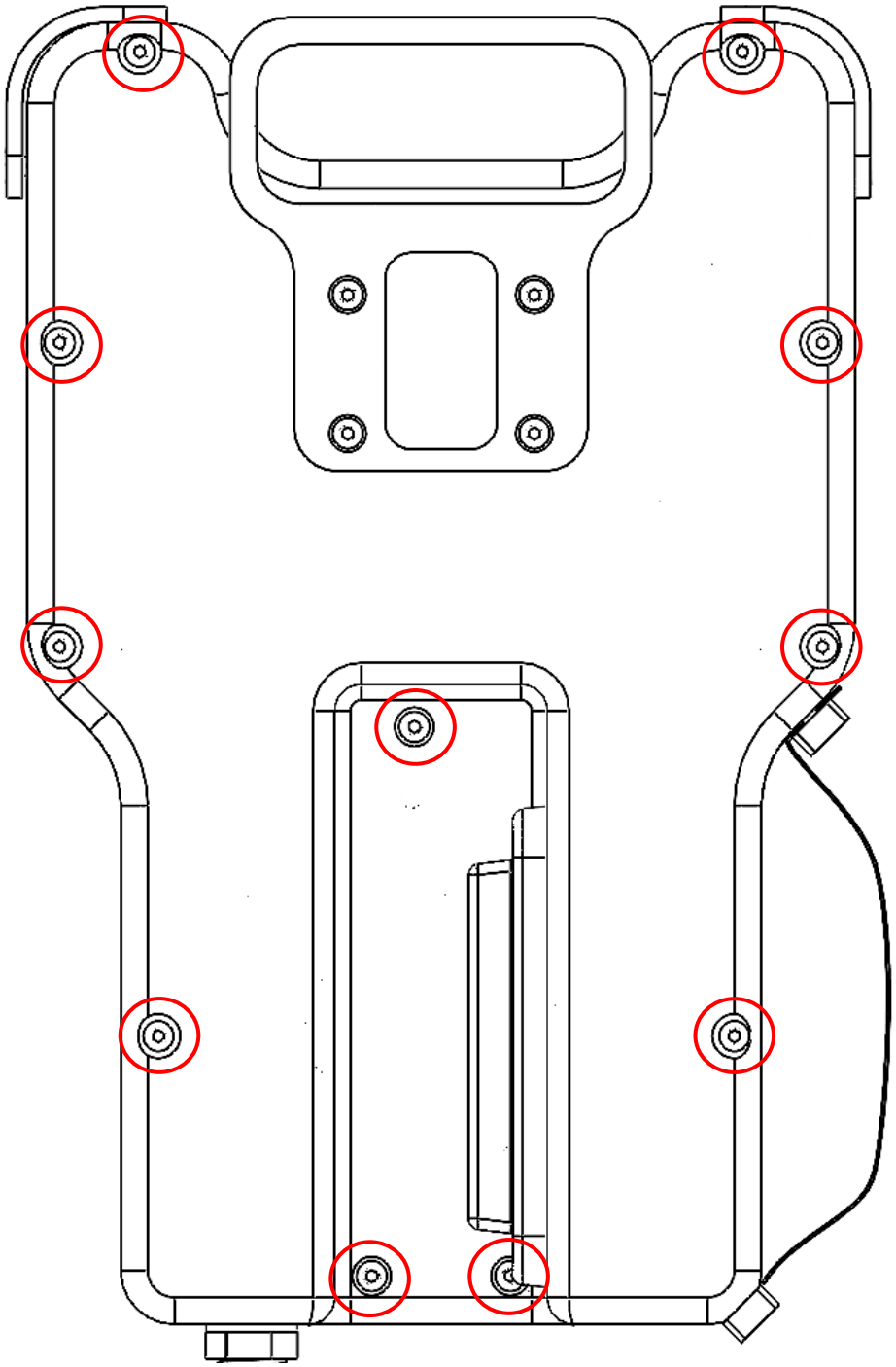
4. Open the astorino software and go to the SYS tab. SETTINGS and then Firmware. If there is more than one item in the drop-down list, select the one with USB Teensy in the name T4_0



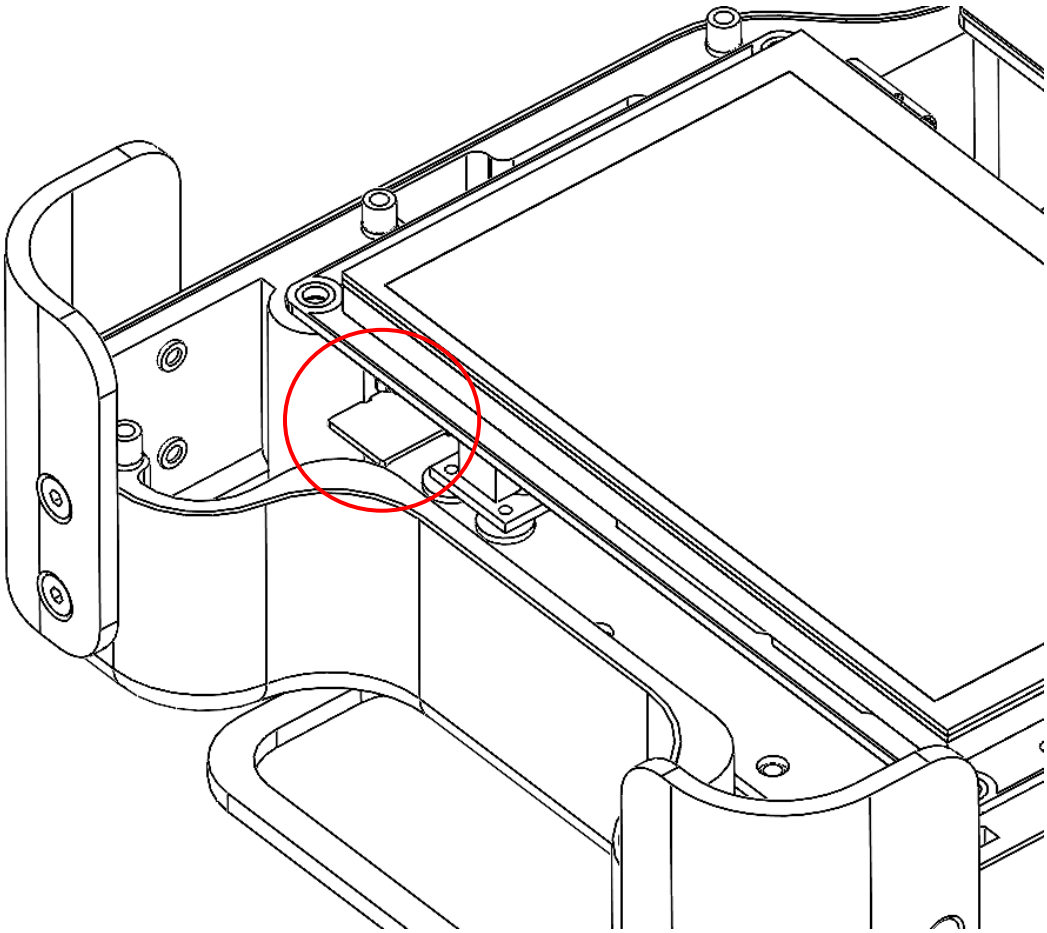
5. Press the Update button and select the *.hex file of the software you want to upload.
6. Wait for the Teach Pendant to reset (beep) and turn off the robot.
7. Upload the screen software.

18.2 Teach Pendant Screen Software Update

1. Upload the *.tft firmware to the microSD card
2. Turn off the robot if it is switched on.
3. Pull off the top of the appliance housing. Remove the M3 screws on the underside of the Teach Pendant.



4. Insert the microSD card into the slot at the top of the screen



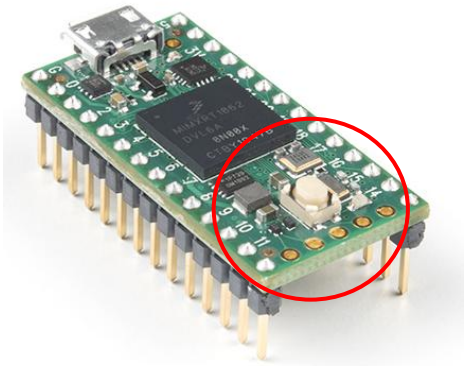
5. Turn on the robot with the Teach Pendant connected and wait until the update process is complete. You will see the inscription: Check Data.. 100% Update Successed!
6. Turn off the robot, remove the microSD card, close the case
7. Turn on the robot – update complete.

18.3 Restoring TP CPU to factory state after failed firmware update

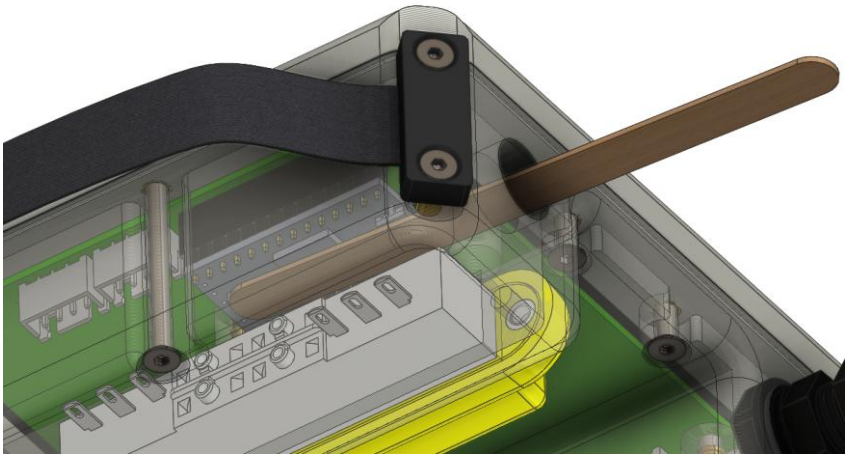
This process might be helpful when firmware update failed and now TP is frozen on the splash screen.

To restore TP CPU to factory state follow listed below steps:

1. Turn on the power,
2. Locate the small white button that is located on the CPU



3. Press and hold it for 15s with nonconductive tool.



4. After process was completed orange diode will start to blink,
5. Upload firmware again.

19 MANUFACTURER DATA

Kawasaki Robotics Astorino
Teach Pendant – User Manual

2025-01: 4th edition

Publication: ASTOR AND KAWASAKI Robotics GmbH